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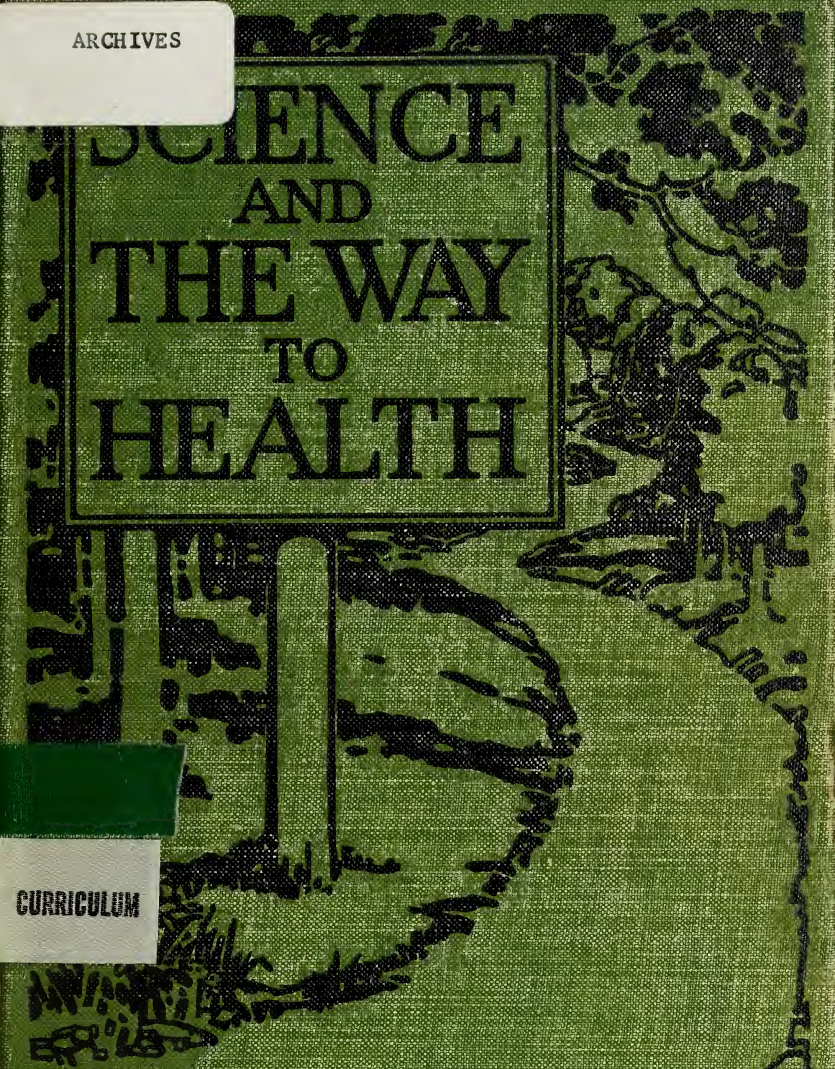

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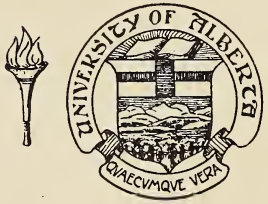

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FLYING ABOVE THE CLOUDS

A successful aviator must have scientific training and good health

SCIENCE AND THE WAY TO HEALTH

BY

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PREFACE

This volume introduces the pupil to the spirit of science in relation to healthful living. It is fair to assume that when pupils have reached the junior high school or corresponding grades they have acquired considerable information about health and have also formed many of the fundamental health habits. Both the acquisition of worth-while information and the formation of health habits should continue, but the pupil should now cultivate a deeper spirit of inquiry and a scientific attitude toward health problems. In a field in which there are so many cults, and so much misleading and even harmful tradition and superstition, the development of a scientific attitude would seem to be the next logical step.

The authors have approached this problem by presenting to their readers some rather unusual information about health and disease prior to the time when science had developed. The futility of superstition is pointed out. The spirit and method of modern medicine and hygiene are also suggested in the lives of great health heroes like Leeuwenhoek, Pasteur, Lister, Koch, Trudeau, Reed, Noguchi, Goldberger, and others. These men were not only scientists, but citizens of the world who devoted themselves with zeal to the public welfare.

The scientific temper, however, is primarily the result of actually engaging in scientific work. J. Arthur Thomson has brought out this point admirably in his excellent essay, "The Scientific Mood." "What is demanded,"

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says Thomson, "is within the reach of all who will habituate themselves in making sure of the facts, in precision of statement, in getting things clear, and in realizing the complexity of all situations. These qualities cannot be acquired passively; the kingdom of science must be taken by force. The scientific mood can only be engendered by one being actively and energetically scientific."

It is obvious that the opportunity offered for scientific procedure will vary with different schools. In the seventh and eighth grades in rural and village schools it may be inconvenient to do much in the way of conducting scientific experiments. For this reason the exercises under the caption "Interesting Things to Do" are such that, while they lend themselves to some extent to scientific procedure and the cultivation of a scientific spirit, they may be carried out without special equipment. The other exercises at the end of the chapters are based upon the principles of the newer types of tests. They are so varied and comprehensive that it is expected they will stimulate the interest and thinking of the pupils.

For the junior high schools and for all other schools of corresponding grade which would like to do more, an accompanying pupil's manual, "Experiments in Health," is provided. It contains about one hundred experiments carefully selected to fit in with the text. These experiments have been so planned that most of the laboratory and class equipment may be made at school or at home and will therefore cost very little. Some of the experiments may be performed at home and reported to the class. Others will be performed before the class, and the results carefully discussed. The subject matter of the text and of the manual of experiments has been tried out by the authors in actual school experience. The illustrations have not

only been planned to explain the text and arouse interest but also to suggest problems and projects. Many of the legends invite careful observation and study, additional reading, or the performing of some experiment.

Although the scientific method and mood are to be among the highly desirable outcomes of the study of this book, the teacher needs to remember that the improvement and conservation of the health of the individual pupil is the goal of greatest worth and ought never to be lost sight of. The slogan of the teacher might well be

Healthier Boys and Girls

With this end in view the teacher will find it profitable to know something about the mental and physical handicaps of her pupils, and, so far as possible, to work with pupils, school physician, school nurse, and parents to remove remediable defects. But health education is something more than the prevention of disease and the removal of defects. It should be wholesome and inspiring, with definite emphasis on positive health — on living in such a way that one's energy may be conserved and spent with the greatest satisfaction and efficiency, both for himself and the community. This means sound and wholesome habits and attitudes of living.

Throughout the text, but especially in Chapters XVIII and XIX, the authors have kept in mind the mental health of the pupil.

The authors are especially indebted to the National Safety Council and other organizations and to teachers for material and suggestions incorporated in this volume.

For the spirit and some of the content of Chapter III, "Valiant Health Knights," particularly of the first few pages, the authors are indebted to de Kruif's "Microbe

Hunters" (Harcourt, Brace and Company). They wish also to express their gratitude to Dr. Percy G. Stiles of the Harvard Medical School, who read the proofs dealing with alcohol and drugs, to Miss Elizabeth Ross, R. N., for her suggestions on home nursing, and to Mrs. Grace Shepardson Kunst, Supervisor of Physical Education, Newton, Massachusetts, for her helpful comments on posture and physical education.

J. MACE ANDRESS
MAUD A. BROWN

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SCIENCE AND THE WAY TO HEALTH

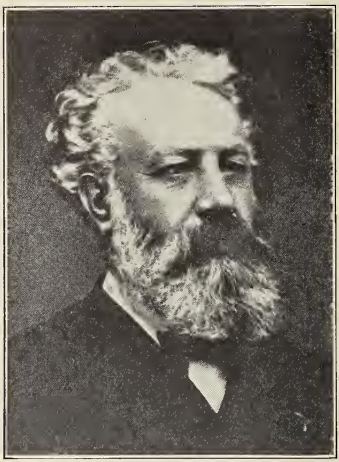
CHAPTER I

THE WONDERS OF SCIENCE

1. The charm of fiction. It was about sixty years ago that Jules Verne wrote his remarkable book entitled "Twenty Thousand Leagues under the Sea." It caught the popular fancy and was widely read by young and old throughout the civilized world. This book described the mysterious voyages of a submarine boat and startling discoveries in the plant and animal world in the depths of the sea. Another book by the same author was "Around the World in Eighty Days."

Half a century ago people who read these books of Jules Verne smiled at his apparent exaggerations. "Yes," they said, "his stories are interesting, but they are only fiction after all." Yet Jules Verne had anticipated in imagination discoveries and inventions that would greatly change the world. But even he, with one of the most brilliant imaginations of all time, could not foresee how quickly a new age was to be ushered in and how it would eclipse in many ways his most fantastic dreams. Boys and girls who read his books today may even find them somewhat commonplace. The real world has marched on in the last sixty years.

2. Truth is stranger than fiction. The world is changing so rapidly that even current fiction may lag far behind actual achievement. The morning paper may tell us of a new discovery or invention that will revolutionize a belief of a lifetime.



JULES VERNE

The great French novelist who anticipated many modern discoveries and inventions

In the days of Jules Verne the circumnavigation of the globe in 80 days seemed a remarkable feat; but in 1889 Nelly Bly did it in $72\frac{1}{4}$ days. In 1903 Henry Frederick made the trip in 54 days. In 1926 Edward S. Evans and Leiton Wells, by careful planning, reduced the time to 28 days. John Henry Mears and Captain C. B. Collyer, in 1928, established the record time of 23 days, 15 hours, 21 minutes, and 3 seconds. In commenting upon this the *Literary Digest* said: "The moon is no longer champion of those who travel around the earth." The initial voyage of Magellan, which took three years, seems very long in comparison.

Wonderful as was the achievement of Mears and Collyer, on August 29, 1929, the dirigible *Graf Zeppelin* completed its flight around the world in 21 days, 7 hours, and 34 minutes. So the story of adventure continues.

How time and space have been eliminated since the time of Washington! The sailing ship of that day was slow and uncertain. Adverse winds might blow it far from its course. At best it took about three months for such a craft to cross the Atlantic. Today the giant *Leviathan* may make the trip in about five days, and in sunshine and storm the great ship may keep in communication with the world. In the ballroom the voyagers may dance to music rendered by orchestras in New York, London, or Paris. On land the transformation in transportation and communication has been just as marked. The stage-coach that traveled twenty or thirty miles a day with difficulty has given way to the swift-moving express train, automobile, or airplane. Little wonder that men in the time of Thomas Jefferson shook their heads over the Louisiana Purchase and wondered how such a vast empire could ever hold together. The marvels of modern invention, making transportation and communication easy, have now dispelled this fear. On February 22, 1927, it was estimated that President Coolidge's address on Washington was heard over the radio by twenty million people in the United States. During the political campaign of 1928 even this record was broken. At one time a network of 106 broadcasting stations was employed, supplemented by about 25,000 miles of telephone circuits. More people heard the presidential candidates than ever before in the history of any country.

This is a remarkable age. It is an age of skyscrapers, submarines, airplanes, dirigibles, phonographs, safety razors, radios, electric lights, steam and hot-water heat, gas stoves, vacuum cleaners, and other wonderful inventions. Many diseases have been conquered, and life has been lengthened. Life has been made more comfortable

and in most ways safer. Such progress has been made that today the ordinary American workman enjoys many comforts and opportunities that were denied kings and queens a few centuries ago.

3. Science the wonder-worker. What has brought about this remarkable change in the world? There is but one answer, — science. This is a word from the Latin, meaning "to know." The most essential thing about science is knowledge, but not all knowledge is science. The ordinary person knows something about mosquitoes, — that they bite and may carry malaria; but to the ordinary boy or girl every mosquito is about like every other mosquito, while to the scientist a particular mosquito is one of a particular species, or group, having certain characteristics. He calls it by its group name and knows whether it is male or female, how it lives, and whether it carries disease. The scientist wants to have his facts classified. He would have a pigeonhole for each fact.

Some scholars are interested in the gaining of knowledge for its own sake; they are not concerned about its being useful to humanity. Such study is often referred to as pure science. Others are intent on finding out how this knowledge may be made useful to the world. This body of knowledge is known as applied science. There is no sharp difference between the two. Nearly all pure science eventually becomes useful.

There seems to be little connection between the sun, over ninety millions of miles away, and the dirigible balloon floating among the clouds. Yet there is a very close connection. One day scientists discovered a new gas, helium, in the sun. Later this gas was discovered on the earth. Meanwhile the dirigible balloon had been made quite successful except that the ordinary hydrogen gas

which was used to inflate it was inflammable. In warfare it often caused an explosion. Since helium was very light and could not burn, it might be used in dirigibles with success. Then began the adventure of searching for it in every conceivable place. Finally it was found in sufficient quantities. In this way pure science had become useful.

THE ROCKEFELLER INSTITUTE

A famous scientific institution noted for its remarkable discoveries in medicine. (Courtesy of the Rockefeller Institute)

Scientists are interested not only in collecting facts and classifying them but in discovering relations between them. They try to find causes. When science was still in its infancy it was noted that malaria was found in low, damp, marshy regions. It was natural to think that low land was the cause of malaria. Scientists had not dreamed that the presence of the mosquito was important. Finding the mosquito guilty was one of the most brilliant discoveries in medicine. Before science had begun, chance observations had shown that in a number of cases people

who had touched toads had had warts later on, and a great many people came to believe, and still believe, that warts are caused by toads. As men began to learn more about the body, and observed more carefully, they found that this was untrue.

A growing body of classified facts and a knowledge of causes gives the scientist increased power in the world. It enables him to predict what will happen. He may predict a coming storm, an eclipse of the sun, or a flood. Knowing the cause of a given disease and the way in which it is carried, he may find the source of an epidemic and conquer it or prevent its coming.

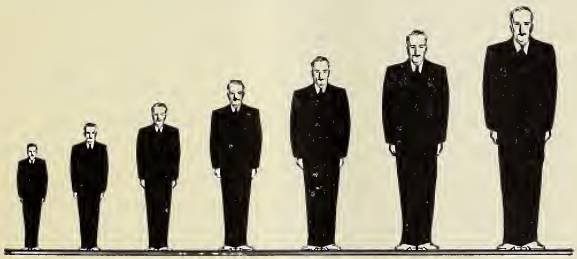
This increasing body of reliable information and knowledge of causes has made man a wonder-worker. It has enabled him to construct bridges, build giant ships, light cities, increase the products of farms, preserve food, and lessen the number of hours of labor.

Science is a wonderful power. It may help to save life and make the world a better place in which to live, or it may help to destroy life. The World War, for example, witnessed the application of science to destroying life on a colossal scale never dreamed of before.

4. Science in the service of health. The story of the contribution of science to health is fascinating. With the growth of science the average length of life has been increased, and many diseases have been conquered. In the United States people are living longer than ever before. According to the 1920 census the average length of life is fifty-six years. Within the last seventy-five years the average duration of life has been increased about fifteen years in many of the nations of the world. It is believed by many health experts that with the further applications of science to the problems of health twenty

years more may be added to the average length of life in the United States. You may help to bring this about.

Glancing back to the past, we notice that the average length of life in the United States as a whole was fifty-one years in 1910 and forty-nine years in 1901, forty-one years in New York City in 1881, and forty years in Massachusetts in 1853. In ancient Rome, without the science of health, it was about twenty to twenty-five years.



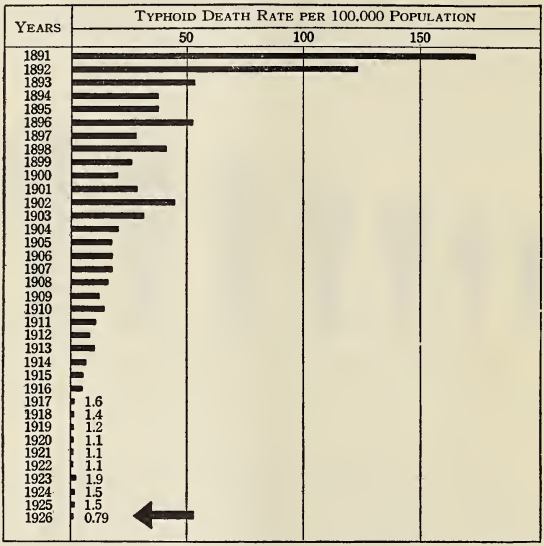
THE AVERAGE LENGTH OF LIFE IS RAPIDLY INCREASING

This is one of the greatest scientific achievements of the last century

As a result of the growth of science many diseases have almost disappeared. That they have not been more successfully combated is due to people's ignorance of the teachings of science, or to their laziness or indifference. Typhoid fever, for example, is far less common today than it was twenty years ago; smallpox is far less common today than it was fifty or a hundred years ago. Professor Caldwell has well said: "We need not have the smallpox unless we prefer *not* to do the things which science has shown will prevent disease." Concerning typhoid he says this illness "is so well understood and its transmission so definitely associated with

uncleanliness that we shall soon see the day when it will be not only unfortunate but not respectable to have the disease."

5. A land where there is no science. In those lands where there is little knowledge of science and its relation to



HOW SCIENCE HAS REDUCED THE DEATH RATE FROM TYPHOID IN THE CITY OF CHICAGO IN THIRTY-SIX YEARS

health, smallpox, fevers, and other diseases are likely to be common. Illness and lack of progress are marked. This is true of many of the South American and Central American countries. Wherever science has been applied, health and the saving of life have resulted. The Panama

Canal Zone is in the tropics, and previous to American control it was one of the most unhealthful places in the world. American scientists have now made it more healthful than many northern cities.

In far-away Zululand in Africa there is no knowledge of science. Data are lacking in regard to the average length of life in that country, but the beliefs and practices of these people are interesting as compared with our own. All the misfortunes of the world are supposed to be due to evil spirits. Good health depends on protecting one's self from such spirits. This is accomplished by getting the help of the medicine man or witch doctor. When consulted he puts on a mask, to make him look wise, and performs various ceremonies to drive the evil spirits away.

© Ewing Galloway

AN AFRICAN WITCH DOCTOR IN HIS MASK, PAINT, AND FEATHERS

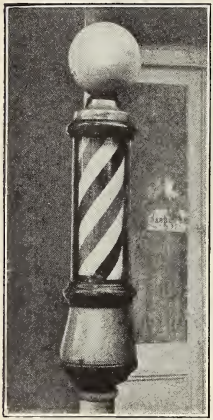
His people believe that he can scare away the evil spirits that cause disease

Dr. Philip A. E. Sheppard, a Boston dentist, who spent many of his vacations among the Zulus, says that he has occasionally extracted teeth for the members of the tribe.

It has always been an occasion of festivities, with the immediate members of the kraal and their dogs admitted. All joined in chanting and singing and clapping of hands, while the dogs contributed their share in the concert most lustily, the

underlying idea of all this being that the patient would not feel pain. At all events, even if he did, they have made sufficient noise to satisfy or frighten the spirits, and the evil after-effects have been warded off.

Among the Zulus, according to Dr. Sheppard, good health is indicated by the power to sneeze. Sneezing thanks are offered to the spirits of ancestors upon occasion. Lucky is the time spent in sneezing, and on occasions the natives will suspend all operations for a time for a sneezing festival. To induce the pleasurable explosions, a kind of snuff is used. It is the custom of witch doctors to sneeze quite a bit during their divinations, and this indicates that the spirits are present and propitious.



THE BARBER POLE
It is a reminder of a time when superstition ruled

6. The romance of the barber's pole. Everybody is familiar with the striped pole that stands in front of nearly every barber shop. Although few people, even among the barbers themselves, know it, this white pole with red stripes tells a strange story of that historic past before the science of modern medicine began. Several hundred years ago barbers were also surgeons. One of their functions was blood-letting. It was believed at that time that nearly all human ills were due to a bad condition of the blood. A loss of blood was supposed to bring relief or to effect a cure. To bring this about, leeches, or blood-suckers, were often applied to the patient by physicians. The surgical function of the barber was to cut the flesh with a lancet to allow the blood to escape. The red stripe

on the barber's pole advertised the barber surgeon and stood for the bandage with which he stopped the flow of the blood. The stripe of blue was added during the Civil War for patriotic purposes. Many barber poles, even today, have also a little metal basin at the bottom of the pole. In the days of barber surgeons this metal basin was used to catch the blood. It is believed that the death of Washington was hastened by blood-letting during his last illness. Even today blood-letting is resorted to by our best physicians for certain maladies, but only after science has proved its value. Although blood-letting is seldom practiced today, and only by skilled physicians who are very careful about having clean instruments and bandages, the striped barber's pole remains, recalling that curious age of beliefs and superstitions about the blood. Not only does the barber's pole remain, but also some of the superstitions of the past, such as

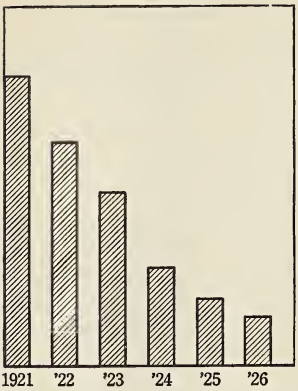
After the cold winter the blood is thick. We need to take medicine to make it thin.

Cereal heats the blood.

Boils are a good thing. They make you healthy because they get rid of bad blood.

Possibly you may know other superstitions about the blood. Make a list of them and then try to find out, by referring to this textbook or to other books or by asking a physician, whether they are true.

7. Our superstitions arose in an age of no science. Among people who have not had the advantage of studying science there are many beliefs about health and disease that are called superstitions. They are based not on science but on an incomplete experience or on imagination, in



DIPHTHERIA ON THE RUN IN INDIANA

Science will rapidly reduce the mortality from this disease to the vanishing point

an attempt to explain something which seemed mysterious. Many of these superstitions have been handed down from generation to generation, not by books but by word of mouth. Many of them doubtless go back hundreds of years to a time when our ancestors lived a very primitive life.

Here is a list of some of the superstitions that are still believed by many people today. There may be a slight amount of truth in some of them. After you have studied this book turn back to this page and consider each one. Try to find out whether there is any scientific reason for believing any of them in whole or in part.

SUPERSTITIONS

Wearing red-flannel underclothing keeps away rheumatism.
If you carry a horse-chestnut in your pocket you will not have rheumatism.
A potato carried in your pocket will prevent rheumatism.
We need to take sulphur and molasses in the spring to thin the blood.
An open winter, a full graveyard.
Boils are caused by impure blood.
Boils make one healthier.
Night air is unhealthful.
Toast dries the blood.

Berry seeds cause appendicitis.
Cocoa coats the kidneys.
Oatmeal is heating to the blood and should not be eaten in the summer.
Fruit and milk taken together curdle in the stomach and poison the blood.
A clean tooth never decays.
Eating meat puts a burden on the kidneys.
Cutting your hair at the time of the new moon makes it thick.
Bury a piece of raw meat under the full moon to cure warts.
Burn gray hairs and they will not multiply.

8. Purpose of this book. In the previous pages we have noticed how valuable science is for happy and successful living. In the pages that follow we are going to consider science only in relation to healthful living. Health is so important for our happiness and success that we need all the information on how to be healthy that has been discovered by the great army of scientists. But this book is concerned not only with knowledge about health but with presenting this subject in such a way that the boys and girls who read it may be led to do the things needed for healthful living.

Try This

After reading the previous chapter carefully, try to fill in the blanks in the following composition:

Fiction has ____ many of the wonders of ____. Current ____ often lags behind ____. Modern ____ have almost eliminated ____ and ____.

"Science" comes from a Latin word meaning __ ____. The scientist not only ____ facts but ____ them.

There are two ____ of ____: (1) ____ science and (2) ____ science. Hygiene is an ____ science. Modern preventive medicine and ____ have ____ the average ____ of life. The ____

length of life in the ____ ____ in 1920 was ____ years. Through ____ living we may still expect to lengthen life about ____ years. In ancient Rome the average length of ____ was ____ or ____ years.

Science has also given man ____ of disease. No community today need have ____ or ____ if they will do what ____ teaches. Where science has been ____ human life has been lengthened. In those ____ where there is no ____ disease is ____ and the length of life is ____.

Barbers were once ____. In those days it was believed that nearly all ills were due to bad ____. The barber's ____ advertised the barber ____. One of our presidents, ____ ____, possibly had his life shortened through ____ letting.

Many common ____ about health and sickness are ____ that arose before the days of ____.

It is worth while to know and ____ the laws of ____ living. It will help to make us ____ and ____.

Interesting Things to Do

1. Look up illustrations from literature showing how prominent writers like Tennyson and Jules Verne anticipated scientific discovery and invention.

2. What is the most recent discovery in medicine or hygiene that you have heard about?

3. Try to get some figures from your state department of health about the lengthening of life or the mortality from typhoid fever during the last twenty years. Present these facts to the class in the form of a graph.

4. Try to find out how the Indians and other primitive people besides the Zulus battled against disease.

5. Look up some facts about the barber's pole.

6. Add to the list of superstitions on pages 12–13.

7. Write a composition of not more than two hundred words describing the difference between a scientific man and one who merely uses common sense.

CHAPTER II

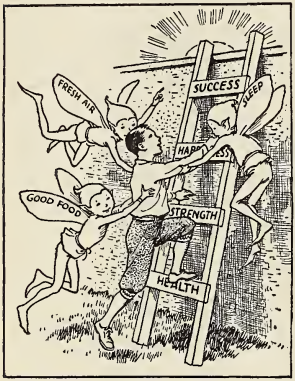
HOW SCIENCE MAY ADVANCE HEALTHFUL LIVING

9. What health means in happiness and success. The boys and girls who study this book are probably in fairly good health; many of them are in excellent health. Those of you who enjoy good health, — who have a keen appetite, strong muscles, good teeth, a clear complexion, good lungs, heart, and digestion, and a mind trained to do things whole-heartedly and well, — are equipped for the greatest amount of success for which you are capable. Because you are so healthy you may think that the subject of healthful living does not concern you, but this blessing of good health may pass unless you know how to keep your good health and practice the rules of healthful living.

Those of you who do not enjoy good health need to stop and ask yourself a few questions. The first question might be, "Can I improve my health?" The answer should be, "Certainly." Almost everyone can improve his health, and some people may have almost perfect health. This will take time, patience, knowledge, and willingness to do the things that are necessary. There are many examples of boys and girls who have done this. Theodore Roosevelt was a frail child, but by hard work he became one of the most vigorous of men. He was called the strenuous American.

Another question worth answering and easily answered is this: "Is health worth while?" The answer again is, "Certainly." Good health is the foundation of everything

worth while. The healthier you are the better is your chance to succeed. Many cities and states will not allow children to go to work until they pass a good physical examination. Certain defects disqualify one to enter certain trades and professions. The railroad engineer must have good eyesight, for upon the keenness of his vision depends the safety of scores of lives and thousands of dollars' worth of property.



HEALTH HABITS INVITE YOU TO SUCCEED

Success in almost any field, whether in trades, professions, or recreation, like athletics, requires health. To be successful in anything one must have the capacity and the willingness to do hard work. Edison is quoted as saying that success is 1 per cent inspiration and 99 per cent perspiration. Yet the ability to do hard work also depends on health.

The person who is in ill health or who is not in excellent health suffers from a handicap. Picture to yourself two people walking along the road called success. The first has a heavy pack on his back marked "The handicap of ill health." He is bent over by his heavy load and looks very tired and discouraged. The other individual has no load on his back. His shoulders are broad, his back straight, his eyes bright. What long, swinging steps he takes. How fast he travels. He is without the handicap of ill health. Is there any doubt as to who will reach the

top of yonder hill? In all probability the one with the pack will never get to the summit unless he can lighten his pack or get rid of it entirely.

10. Keys to health: knowing and doing. There are two things which we need in order to acquire and retain good health. The first of these is knowledge about the things that promote good health. It is here that science may make its contributions, based upon the many careful experiments and investigations that have been made. In those countries where knowledge about healthful living has made greatest progress there has been the greatest improvement in healthful living; in Zululand the medicine man administers to his patients the most disgusting medicines, because he is ignorant of science.

BAD HABITS AND ILL HEALTH HINDER SUCCESS

But, important as the knowledge about health may be, some people are healthy without possessing much of this information, because they were born with good bodies and have practiced more or less unconsciously the laws of healthful living.

Accurate and scientific knowledge about health is helpful only when people act in the light of that knowledge. Science may tell us what to do to be healthy; the responsibility of such doing depends upon ourselves.

What are the specific requirements for healthful living?

11. Nutritious food. One of the most important needs for healthful living is the proper amount and quality of food. Before there had been any scientific study of foods it was said that appetite was a sufficient guide. This statement is still made by people who are ignorant of the latest developments of science. Appetite might be a sufficient guide if it were trained in childhood and if there were always a chance to get the right kind of foods. As it is we find children and adults who refuse the vegetables so necessary for health and who eat large quantities of candy and pastry. Following the appetite often means having a finicky appetite, which is detrimental.

ONE OF CHICAGO'S HEALTHIEST HIGH-SCHOOL GIRLS

Medical and health experts gave her first honors. Why shouldn't she look happy?

So many studies have been made on animals and human beings that we now know a good deal about the essentials for a good diet. Many pages of this book will be devoted to this subject. Let us note briefly the three essentials of the most satisfactory diet as suggested by Dr. McCollum.

1. His studies show that the consumers of dairy products have been healthy and progressive peoples. It was

probably this kind of diet that made the pastoral folk so superior to other people. We are now drinking about a pint of milk a day per person in the United States. This amount of milk should be increased to one quart. Coffee and tea, especially for children, should be eliminated.

2. The diet should be liberally supplied with leafy vegetables, such as lettuce, chard, and beet tops. The leafy vegetables provide the body with valuable minerals and growth material that cannot be supplied adequately from the milled products, tubers, and muscle meats that are so popular in our diet.

© Bachrach

DR. E. V. McCOLLUM

Distinguished American scientist and authority on foods

3. Dr. McCollum recommends the consumption of a certain amount of raw vegetable food daily. This prevents scurvy and makes for health. Fruit and vegetable salads are especially valuable.

When these three requirements have been fulfilled, one may safely eat white-flour products, tubers, root vegetables, sugars, and meats.

12. Fresh air. Human beings require air to breathe. All scientists are agreed that outdoor air is best, and that indoor air is good so far as it is like outdoor air. It was once thought that indoor air was inferior because human

beings breathe out so much carbon dioxide and other poisons. Many experiments now show that this is true only in part. The air which we breathe in should be free from dirt and disease and should be moist so as not to irritate the delicate lining of the nose and throat, but the air surrounding the body must be at the right temperature

RECREATION IN THE FRESH AIR AND SUNSHINE PROMOTES HEALTHFUL LIVING

for comfort and health. Men have been confined in air-tight cabinets, and they began to suffer after a short time, but this discomfort ceased when the temperature was reduced. It was found that one could work comfortably in one of these cabinets if a fan kept the air in motion. Such experiments indicate that the discomfort which one suffers in a crowded room is due to the overheating of the body. About 68 degrees is the proper temperature for homes and school buildings. Everybody should try to get as much outdoor air as possible.

13. Sunlight. Not only can the body keep the proper temperature more easily out of doors, but it also has the advantage of sunlight. The study of the effect of sunlight is one of the latest and most fascinating studies of science. Its importance was first recognized in connection with rickets. It was noticed that children who were exposed to the rays of the sun did not have rickets, and that rickety children, when exposed to the sun, rapidly improved. Children suffering from tuberculosis also rapidly improved when treated by sunlight. Experiments on many animals showed that sunlight is a necessity for health. The sunlight that comes through glass, however, loses its healthful properties in large measure. This is another reason why everyone should get out of doors daily.

14. Exercise in the open air. Over half of the body is made of muscles which enable us to do things, — to work and to play. Therefore it is quite necessary for us to keep them in good condition. If they are not used, they become pale and flabby. So many people today live in cities and are engaged in mental and sedentary occupations that they neglect to use the large muscles of the body, such as the abdominal muscles. Such muscles may be exercised by special exercises in the gymnasium, but to most people it is more enjoyable to get such exercises in the open air. Nearly all active games make use of these muscles. Exercise makes the muscles stronger, leads to deep breathing, strengthens the heart, stimulates the appetite so that food is consumed with greater relish and in larger quantities, and helps to prevent constipation.

Everybody should spend a part of the day out of doors in play.

15. Taking time for play and recreation. Everybody needs to drop his work entirely at some time in the day and play in the open air or have some kind of recreation, like going to a theater, listening to good music, or reading poetry. The form of play and recreation should be quite different from one's regular work, so that one may rest the mind and body and thus return to work with greater zest. So far as possible everybody should cultivate some kind of play or recreation in the open air. Photography, sketching, camping, fishing, boating, horseback riding, baseball, tennis, gardening, and bird study are worthwhile interests that would take one into the open air.

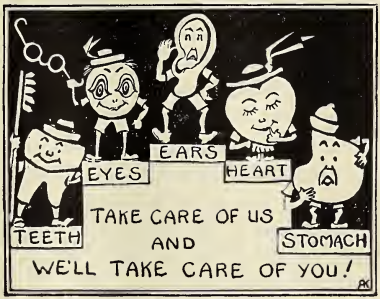
16. Plenty of rest and sleep. To do one's work well and be happy, it is necessary to learn to rest. This is very difficult for many boys who wish to be active all day. While some people need rest much more than others, nearly everybody could profit by having a little rest just before and after meals. This is especially true of those who are under weight.

One of the best habits to form is that of going to bed early. Boys and girls of junior-high-school age should get at least nine or ten hours of sleep every night. This can usually be done if one is careful to plan the day's work and recreation wisely.

17. Standing tall and sitting straight. Good health depends in part on the freedom of the internal organs to do their work. Good sitting and standing postures give the heart, lungs, and digestive system a chance to perform their proper functions. Besides being valuable for health, good posture makes one more attractive. The round-shouldered and bent-over young man or woman does not make a favorable impression in the drawing-room, in the schoolroom, or on the playground.

Poor posture is often due to improper nutrition, overfatigue, lack of sleep, and general ill health. Sometimes it may be due to careless habits.

18. Good medical advice. The body is a wonderful machine which may run for a long time without any serious trouble. Like any machine, it needs good treatment. It is desirable to go to the dentist regularly about every six months, whether you think your teeth need attention or not. In case of illness consult your physician without delay. Just as it is desirable for every owner of an automobile to look his car over from time to time, so it is profitable for everybody to have a good physical examination at least once a year. Some schools give their pupils this annual examination.



SOMETHING TO THINK ABOUT

19. Avoiding accidents. This is a dangerous age. The number of automobiles is increasing yearly, and the danger in crossing the ordinary street is now greater than in crossing a railroad track. There are also many accidents from burns, falls, and cuts. Some of these accidents are unavoidable, but many of them are due to carelessness and could be prevented. For example, many people are hurt or killed every year in boarding cars and trains in motion. Every day one may see a number of people who take chances with their lives. The better way is to

train yourself to look out for your safety and the safety of others. Such habits would do much to prevent accidents.

20. Training to meet emergencies. Since accidents will happen and emergencies will arise, everybody should be trained to do the right thing at the right time. Every summer many people lose their lives while in swimming, but many others are saved from drowning because their companions have been trained to save life. For one's own personal safety it is necessary to know how to take care of cuts, wounds, and bruises.

21. Avoiding illness. It is not always possible to avoid being sick, but the chances may be greatly reduced if one tries to keep physically fit and avoids the possibility of infection. Washing the hands before eating, for example, is one excellent way to avoid catching a cold or other disease. This important subject will be discussed in some detail in the chapters which follow.

22. Keeping healthy mentally. Success in life depends not only on a healthy body but on a healthy mind. Although a healthy body tends to promote mental health, this does not tell all the story, because a person, while physically fit, may form habits of dependence, laziness, and refusal to face difficulties, that will later cause him much pain. Chapter XIX will offer suggestions in detail.

23. Health habits are like money in the bank. Learning the principles of healthful living will have no value unless they are practiced. The only way to practice these rules with regularity is to keep doing them so constantly that after a time they are done without thinking. If we can remember to go to bed every night at nine o'clock, it will finally get to be a habit. When such habits are formed, it seldom is necessary to think about health. We then do, without thinking, the things that will make us healthy.

A person who has formed such habits has something that is as valuable as money in a bank. How much money have you in the health bank?

Try This

After reading each of the following statements, write a short sentence that will give the best reason why you think each of the statements is true. Let the members of the class compare. Which reasons are the best? Why?

1. Health concerns everybody.
2. Nearly everybody can improve his health.
3. Health is one of the fundamentals of success.
4. Our health depends in large measure on the habits we form.
5. The appetite is not always a good guide.
6. Ordinarily the most important quality of the air we breathe is its temperature.
7. Exposure to sunlight is desirable for health.
8. Good health requires the exercise of the muscles.
9. Recreation should be different from one's regular work.
10. It is desirable to rest a little before and after meals.
11. Bad posture may be due to other bad habits.
12. It is a good plan to visit the dentist every six months.
13. Most accidents are preventable.
14. Everybody who studies this book should know how to take care of a cut.
15. The use of an individual towel prevents disease.

Interesting Things to Do

Make a list of the health habits which should keep you well and make you grow as you should. Plan to practice some of these habits until they are formed.

CHAPTER III

VALIANT HEALTH KNIGHTS

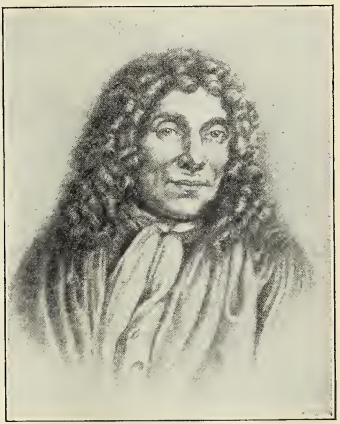
24. A challenge to man. Since the beginning of history illness and death have been a challenge to man. They have inspired his fear, resourcefulness, and courage.

At the beginning all was mysterious, but primitive man craved some explanation for sickness. Since science had not begun, he resorted to imagination and superstition. Early man was interested in the prevention of disease. Early in history, for example, it was known that water had something to do with disease. Cyrus the Great of Persia, in his great military campaigns, took water from home for his army. The Greeks and the Romans made some progress in medicine, but superstition still held on. Even as late as the seventeenth century Sir Kenelm Digby suggested as a remedy for fever that the physician "pare the patient's nails, put the parings in a little bag, hang the bag around the neck of a live eel and place the eel in a tub of water."

Amid the gloom of the Middle Ages disease flourished. Great plagues swept over Europe. This was to go on until science could tell what caused disease and so cure and prevent illness.

Beginning with the seventeenth century there was light. Now enter the lists a long line of heroes who often lost their lives in the battle for humanity. The story of this conquest of disease — a conquest which is still going on — is one of the most fascinating stories of civilization.

25. The man with the microscope. Strange to say, the first of these valiant knights that laid the foundation for modern medicine and hygiene was not at all interested in health, and died without knowing how much he had done for the world. He was a Dutchman named Leeuwenhoek (pronounced lā′vẹn ho͝ok), who was born in 1632 among the brown windmills, narrow streets, and sluggish canals of Delft. His family were basket-makers and brewers, — trades highly honored in those days. His father died at an early age, and his mother sent him to work in a dry-goods store in Amsterdam. At twenty-one he married and started a dry-goods store of his own. For twenty years little is heard about him except that he was appointed janitor of the city hall at Delft and that he developed a passion for grinding lenses. Leeuwenhoek was not an educated man. He did not know Latin or Greek. He knew only his native Dutch tongue, despised at that time by scholars. He was not in contact with cultured or scientific men. Yet there was one thing that he could do, and that was to grind lenses. He went to spectacle-makers and apothecaries and everybody who might be able to tell him something about making



LEEUWENHOEK

One of the first of the health heroes. He became famous because of his discoveries with the microscope

lenses. For twenty years he labored unknown to the rest of the world. For fame? No. He worked just for the fun of seeing through a lens things that he could not see with his naked eye. His neighbors looked upon him as a crank and made fun of him, but he went on running his store, looking after his janitor work, grinding lenses, and peering long hours at the strange things under his microscopes, until finally he had the best lenses that had ever been made.

Our hero was as curious as the most curious child you have ever seen. He would look for long hours at the hair of a sheep, the scales of his own skin, or the legs of an insect. There was almost nothing that he did not examine. After he had found things not once but dozens of times or even hundreds of times, he wrote down very carefully what he had seen. One day — perhaps the greatest day in the history of science — he put a drop of stagnant water on the needle of his microscope and looked. There under his lens was something that mortal man had never seen before, — little creatures swimming and cavorting around. There was a new world of tiny creatures that had lived and battled and died unseen of man from the beginning of time. It was an exciting moment, — as exciting as that minute when the watchman on the lookout of one of Columbus's ships cried out "Land! Land! Land!" and America was found.

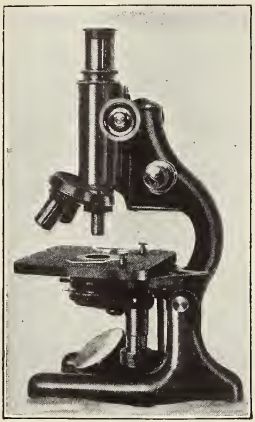
With Leeuwenhoek began the story of the hunt for microbes, or germs. Every minute that he could get he hunted for microbes. He found them everywhere, — in his food, in the water, and even in his own mouth. Curiously enough, after he had been drinking very hot coffee he could find no microbes in the scrapings of his teeth. He tried many experiments. After he found these agile

little particles swimming around in water, he heated the water until it was quite hot. Then he put a drop of the water under his microscope. Lo and behold, the microbes had stopped their running to and fro. He cooled the water, but they did not come back to life. Leeuwenhoek had made a great discovery, namely, that *heat kills microbes.*

The intense curiosity of Leeuwenhoek led to other interesting observations. One day, as he was looking through a microscope at the tail of a fish, he noticed that the blood in the tiny arteries divided and subdivided into smaller and smaller hairlike tubes, and that these came together again in larger tubes and made the veins. The tiny microscopic tubes connecting the arteries and veins were finally called capillaries (from the Latin *capillus*, "a hair"). The great English physician Harvey had already discovered that the blood circulated (went around the body, from the heart back to the heart), but he was entirely at sea as to how this was accomplished. Leeuwenhoek's work, along with that of another scientist, Malpighi (mȧl pē'gē), solved the mystery. (Find the capillaries in the illustration on page 158.)

Meanwhile the achievements of Leeuwenhoek began to be noised abroad and finally reached the ears of the Royal Society of England, who invited him to write to them about his discoveries. Those were curious letters, in which the writer, in an unpolished Dutch tongue, rambled along, telling about his own health, the remarks of his ignorant neighbors, and some of the current gossip; but sandwiched in between these remarks were pithy observations about the wonderful things he had seen under the microscope. For fifty years Leeuwenhoek sent these remarkable letters to the Royal Society.

Finally all Europe knew of the strange doings of the Dutch janitor and storekeeper. The Royal Society made him a Fellow and sent him a gorgeous diploma in a silver case. Peter the Great came to see him. The Queen of England came all the way to Delft to see the wonderful sights to be seen under his microscope.

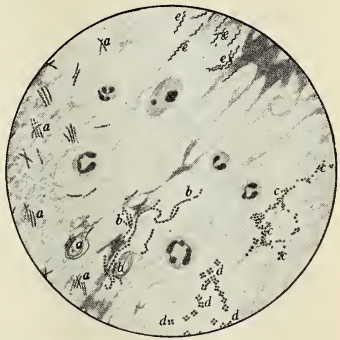


A NEW WORLD WAS REVEALED THROUGH THE MICROSCOPE

Leeuwenhoek lived to be ninety-one, and he was a student to the last, always studying the strange life under his lenses. Yet at the time of his death he was little more than Europe's great showman. Microbes were merely curiosities. Nobody seemed to have any idea how directly this previously unknown and unseen world affected man, — that most microbes were friendly, that some could be harnessed and made to do much of man's work, and that others were assassins bent on destruction.

26. Interesting facts about microbes. When Leeuwenhoek discovered microbes, he thought that they ought to have arms, legs, mouths, stomachs, and brains. Although he tried constantly to improve his lenses, he was unable to see these parts. Today we know that microbes are quite different from other forms of life with which we are familiar. They have none of the special organs found in the higher plants and animals. Unlike the human body, which is made up of vast numbers of cells, they are one-celled organisms. Under the microscope they sometimes

look like little bits of jelly. They are so tiny that fifteen millions of millions of a particular kind would weigh no more than an ounce; yet these tiny forms are able to perform all the functions of life. Some of them are so tiny that they cannot be seen with the most powerful microscope that has yet been invented; but although they are ultra-microscopic, yet in spite of their tiny size these little organisms breathe, take food, throw off waste products, and grow.



BACTERIA AS SEEN UNDER THE MICROSCOPE

a, bacilli; *b*, *c*, *d*, cocci; *e*, spirilla

Some of the microbes are little animals, but by far the greater number are little plants and are generally called bacteria. There are three great groups of bacteria, classified according to their shape. Some are spherical, like minute berries. They are called cocci, from a Greek word meaning "berry." Another group includes all the bacteria that are rod-shaped. Under the microscope some of them look like long, thin sausages, while others are thicker and shorter. They are the bacilli, from a Latin word (*bacillum*) meaning "stick" or "rod." The third group are elongated, like the bacilli, but they are curved and twisted somewhat like a coiled spring. They are called the spirilla, from a Greek word meaning "coil."

27. Do microbes have parents? The microbes discovered by Leeuwenhoek might have been forgotten for a long

time if the scientists of Europe had not got into a heated argument about the origin of life. Since microbes and certain lower forms of life were frequently found in decayed material, many people began to believe in spontaneous generation. They thought that life was created not from previous life but from material things. There were most absurd ideas. One scholar even went so far as to publish a recipe for the creation of mice. Some rags and a bit of cheese or grain placed in a corner might be expected to bring forth a flourishing colony of mice where none of these animals had existed before. Beef tea in a jar, if allowed to stand in a warm place for a number of hours, would be found to swarm with microscopic creatures. Meat placed in a box or a jar would soon be infested with maggots.

This theory received a severe setback when an experimenter discovered that when a piece of gauze was tied over the mouth of a jar containing decaying meat, no maggots developed. The mother blowfly was attracted to the surface of the gauze, where she laid some eggs. Later these eggs developed into maggots. Such an experiment suggested that life comes from life.

Among the men who took a keen interest in this argument was a scientist named Spallanzani, who was born in northern Italy in 1729. He tried many experiments. In the British Isles another experimenter put some hot mutton gravy in a bottle and plugged it up tight. He even heated the bottle and gravy in the ashes. "Now," he thought, "the little creatures and their eggs are dead." Yet in a few days, when he examined the fluid under the microscope, he found it swarming with life. That seemed to prove that life had been created spontaneously. Spallanzani thought that something was wrong. He tried simi-

lar experiments, except that some of his flasks were boiled for an hour and sealed in an intense heat. He boiled some of those that were sealed for only a few minutes. Others were simply corked. After a number of days he examined the contents of the flasks and found that there was no life in those flasks that were boiled for an hour. There were a few live bacteria in those that had been sealed and boiled for a few minutes. In the liquid that had been simply corked he found swarms of living organisms. This experiment proved that microbes were so small that they could get through the tiny apertures of a stoppered bottle, that some microbes could withstand even boiling, but that no life appeared when microbes were killed by intense heat. This experiment did much to silence those who believed in spontaneous generation. The many ingenious experiments of Pasteur and others later proved beyond question that life always comes from life.

SPALLANZANI

One of the early scientists who did much to prove that all life springs from previous life

In his study of microbes Spallanzani discovered a way of isolating a single one. Then he saw a most remarkable sight, the possibility of which had been suggested by another investigator. The little rodlike organism under his

lens began to get thin and thinner in the middle. Finally there was nothing more than a little thread, like a spider's, between the two halves. These began to wiggle desperately until they fell apart. Each microbe was a little shorter than the parent microbe, but that was the only difference. As the astonished investigator studied the small microbes they seemed to grow before his eyes until finally, to his amazement, in about twenty minutes the two microbes split up again, so that there were four in all.

THE WAY ONE BACTERIUM DIVIDES AND BECOMES TWO BACTERIA
They multiply very fast. (After Hilliard)

28. Rapid growth of bacteria. It is now known that it is not uncommon for bacteria to divide every fifteen minutes. Such speed in reproduction is entirely unknown in the life of the higher plants and animals. Let us suppose that we are looking at a single microbe. In fifteen minutes, under favorable conditions, there will be 2; in thirty minutes, 4; in forty-five minutes, 8; at the end of an hour, 16. By the end of the second hour the original bacterium would be surrounded by about 256 descendants. In three hours there would be about 4000, and in four hours there would be about 64,000. In twenty-four hours the number would have increased to 78,700,000,000,000,000,000,000,000,000.

Fortunately this number is seldom if ever realized in nature, because of unfavorable conditions. Extreme heat, bright sunlight, and poisons may kill them. They may also perish for lack of food.

29. Life prolonged by spores. Some of the microbes are able to survive under unfavorable conditions because they develop spores. A spore is a shining mass with a dense

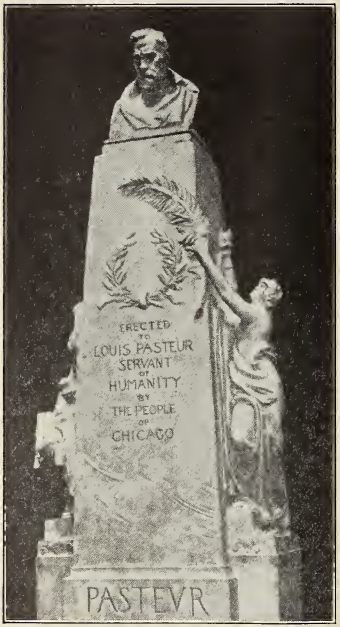
covering, or membrane, which develops in connection with the parent cell. Usually only one is formed in a single organism. It may be placed at the center of the microbe, at the end, or between the center and the end. The germ of tetanus, or lockjaw, produces a spore at one end of the parent rod, which looks like a drumstick. Enough of the life of the microbe enters into the spore to sustain life at a very low ebb. Many of these spores have such resistance that they can survive boiling for several hours, drying, and chemical poisons which would ordinarily prove fatal. Under favorable conditions the spores will again develop as original bacteria and multiply with great rapidity. It is indeed fortunate that those microbes having spores are, with very few exceptions, not enemies to man.

GERMS FROM A WOUND

The lighter bodies at the swollen ends of the rod-shaped cells are the spores of tetanus germs

30. Pasteur the master of microbes. After the discovery of microbes there was very little investigation in this field. Microbes were still nothing more than curiosities. The twentieth century was well under way before it was shown that microbes might be useful or be a menace, and that they ought to be controlled. The man who did more than anybody else to lay the foundation of modern bacteriology was Louis Pasteur, one of the most brilliant minds in the history of science.

Louis Pasteur was born in Dôle, France, in 1822. His father was a tanner, as were also his grandfather and great-grandfather. It looked as if Louis would be a tanner, too, but fate had other things in store for him, for he had rare talents and his parents were ambitious for him. He was not a brilliant student in the primary school, but his teachers were much impressed by his vivid imagination. His father used to help him in his lessons. Finally it was decided to send him to school in Paris.



LOUIS PASTEUR

A great scientist, a devoted citizen, everything for others, nothing for himself. He saved more lives than Napoleon lost in his wars

One cold, rainy morning in 1838 he took the coach for the French metropolis. Pasteur loved his studies, but he became dreadfully homesick. "If I could only get a whiff of the tannery yard I should be cured," he said. His father took him home for a time, but after studying in a neighboring institution for some time he returned to Paris, where he subsequently became a student at the École Normale. He soon won

distinction as a chemist. At the age of twenty-six he became a professor of chemistry at Strasbourg, and later at Lille and at the École Normale.

31. Discovery of the cause of fermentation. There was never a time when people did not know about fermentation; they noticed it in the spoiling of their food and in the making of bread; but previous to the time of Pasteur men knew nothing about the cause. They simply knew that sugar fermented and that crushed grapes and barley sprouts were mysteriously changed into alcohol and carbonic acid. Finally scientists began to study yeast. They found that it was a microscopic plant that put out buds which broke off from the parent plant to form new plants. A German scientist named Schwann found that it was only when yeast was present that sugar and water would ferment. He believed that yeast was the cause of fermentation.

At this point Pasteur began his study of fermentation to help out a manufacturer at Lille. He studied the fermentation of milk and other things as well. He noticed that when milk soured, little gray patches were formed at the bottom and sides of the container. This gray substance contained tiny globules smaller than yeast. This he identified as the ferment of milk,—one of the plants known as bacteria. Further study convinced him that the fermentation of each substance was caused by its own particular ferment.

For some time it had been known that wines could get sick in much the same way as animals and human beings do. They became so sour and disagreeable to the taste that people would not drink them, and the manufacturers lost heavily. Pasteur discovered by means of the microscope that the sick wines contained not merely yeasts but

also other rod-shaped bodies. The latter he at once believed were the cause of the unhealthy fermentation. These foreign ferments, he told the manufacturers, could be destroyed by heating the wines to a certain temperature. This would not destroy the flavor of the wine. Through this discovery Pasteur saved one of the great industries of France. The process of heating a liquid to a temperature just sufficient to kill harmful bacteria finally came to be known as pasteurization. Every large city today pasteurizes its supply of milk and so saves the lives of thousands of children and adults every year.

32. Pasteur and the silk industry of France. When Pasteur discovered that microbes were responsible for diseases of wines, the idea came to him that perhaps microbes were also the cause of diseases among animals and human beings. He soon had a chance to test this idea.

France is a great silk-producing country. During the time of Pasteur the income from silk amounted to millions of francs every year. It was such a great industry that the welfare of thousands of people of southern France depended on the silkworm. The mulberry tree, on which the worms fed, was called the "Tree of Gold." The silkworms made cocoons from which the silk was spun.

For many years a disease had attacked the silkworms. Little spots like grains of pepper on the silkworms indicated the disease from which they sickened and died. Every kind of remedy was tried on the poor worms. Finally the brilliant scientist Pasteur was called to save the industry. For six years he labored. He found that there were really two diseases instead of one, and that they were caused by microbes. Since the disease was hereditary, he suggested that the disease could be prevented if the farmers would choose for breeding purposes eggs from

worms that did not have the disease. This was tried. The disease disappeared, and prosperity smiled again on southern France. Pasteur had won fame and the gratitude of his countrymen.

33. A chance discovery by Pasteur. As Pasteur continued his experiments he discovered, purely by chance, something very important. Chicken cholera was prevalent during his day. It sometimes destroyed as many as eighty or ninety out of every hundred in a flock. Its cause was found to be a little speck which grew very rapidly in chicken broth. A very small drop of this culture would kill a chicken. One day he inoculated some fowls with a little of the culture that had been standing for quite a long time. He found to his surprise that, although they became ill, they subsequently recovered. Later he inoculated them with a fresh culture. He naturally expected them to die, but they were not even ill, although other fowls that had been inoculated with the fresh liquid died. Pasteur found that when the microbes of chicken cholera were exposed to the air, they became weak. When healthy fowls were inoculated with these weakened microbes, they were made immune, — incapable of getting the disease. This was the principle of vaccination, which had already been used against smallpox.

34. Conquest of anthrax. Pasteur now found a new way to serve France. The herds of France were being ruined by a disease called anthrax. Animals that took the disease sickened and died in a few hours. It seemed to linger in particular pastures. The peasants referred to them as "cursed fields." Horses, cows, and even human beings contracted the dangerous illness. Pasteur set to work to weaken the bacteria of anthrax, in order to protect animals against the disease, and finally announced his success.

There were many men who derided this idea of Pasteur's, and one of them, the editor of a veterinary journal, challenged him to a public trial of his anthrax vaccine. Pasteur accepted the challenge. It proved to be one of the most famous events in the history of medicine and hygiene.

The conditions of the test were as follows: An agricultural society was to furnish fifty sheep. Half of them were to be vaccinated with the weakened microbes and later inoculated with the fresh culture; the other half of the flock were to receive the fresh culture only. Pasteur made the prediction that the unvaccinated sheep would die and the others would live.

On May 5, 1881, a great crowd gathered to see the first vaccination. Most of those present thought Pasteur would fail, but he seemed very confident of the result. The second vaccination occurred on May 17. On May 31 the entire flock of fifty sheep were inoculated with the deadly virus. On June 2 a great crowd assembled to see the results. It turned out exactly as Pasteur predicted. One by one the unvaccinated animals fell down dead, while those that had been vaccinated went on chewing their cuds or peacefully eating, all unconscious that they were the subjects of a brilliant experiment.

35. Joseph Meister's life saved. Another dread disease that invited Pasteur's attention was hydrophobia, or rabies. It is caused among human beings by the bite of a mad dog. It was looked upon with horror by the great mass of people, because it usually ended fatally and with great suffering. Taking his cue from the successful experiments with chicken cholera and anthrax, Pasteur, after discovering that hydrophobia attacks the nervous system, found a way of weakening the virus until he could vaccinate animals against the disease. It should be said that

Pasteur was very kind and sympathetic in handling animals, but he believed, as many others believe, that it is best for some animals to die if by this means it is possible to save the lives of many human beings. As we have noticed in the case of anthrax, such experiments on animals have saved the lives of hundreds of thousands of other animals.

A SAFE DOG

He cannot transmit rabies because he is inoculated against it. This was made possible through the discoveries of Pasteur

Up to this time Pasteur had never treated human beings. He said: "I believe my hand will tremble when it comes to deal with man." But one day a nine-year-old boy was brought to Pasteur's laboratory by his mother. The little fellow on his way to school had been bitten by a mad dog. The boy's mother implored Pasteur to treat the boy. Pasteur was greatly touched by the sufferings of little Joseph Meister, and finally, on the advice of his medical friends, began the injections. They were successful and Joseph lived. Other successful treatments followed. People who had been bitten by mad dogs came to Pasteur from all parts of Europe. Funds were raised for a Pasteur Institute, where further researches might be carried on and treatment given. By 1912 more than thirty thousand treatments had been given. The mastery

of hydrophobia was the last great victory of Pasteur. He died in 1895 at the age of seventy-three.

36. Pasteur's contribution. The name of Pasteur became a household word. He was regarded not only as a great scientist but as a great man. Honors were showered upon him not only at home but in foreign countries. His grateful country voted him a pension of twenty-five thousand francs.

In surveying the great discoveries of Pasteur, Dr. W. W. Keen says:

> He discovered the real cause of fermentation and then of putrefaction. He laid the ghost of spontaneous generation. He built the foundations of bacteriology. He proved the germ theory of disease. He saved for his beloved France the several industries of beer, of wine, of vinegar, of silk, of cattle, of poultry, of swine. Better than any one of these, he showed how to abolish childbed fever and hydrophobia among his fellow men.

Pasteur not only proved in a number of cases that microbes were the cause of disease, but also showed how to cure disease, and, better yet, how it might be prevented. Pasteur directed the attention of the scientific men of his time to the menace of microbes. He began that battle against them which is still going on and may continue until disease is entirely conquered. He laid the foundation of modern medicine and hygiene.

37. How microbes invade the body. As scientists accepted the theory and the fact that microbes are the cause of disease, the next question naturally was, How do they get into the body? If their entrance could be prevented, then disease might be prevented.

Research showed that ordinarily diseases cannot get through the skin unless there is some cut or break. Any opening in the skin may be dangerous or even fatal. It is

in this way that the germs of tetanus, or lockjaw, and other infections gain entrance. How necessary it is, then, to keep all skin wounds clean and to apply iodine to kill the germs. As we shall see a little later, the bites of insects open another way for germs to enter.

The other natural openings into the body, especially the nose and mouth, offer routes for infection. Water, food, and air are all means of carrying disease.

38. People as carriers of disease. Some people have an abnormal fear of disease germs, and fancy that these have means of propelling themselves through the air like birds. This is not true. They may be carried several feet from a human being by coughing or sneezing, and so be a menace to the person who breathes the contaminated air, but most of them settle to the floor or ground and soon die. Sunlight is a prompt killer of germs. Most of them die within a few minutes when exposed to bright sunlight.

It should be remembered that most germs are not disease germs, and that even these may live in the body indefinitely without doing any harm. Disease germs cannot live long outside of another body, or host. While man sometimes catches the diseases of animals, nearly all the serious diseases have human beings for their hosts. Sick people are therefore a menace. The dishes that they eat from and the things that they touch may be a means of carrying disease. The person who has a cold and wipes his nose on a saturated handkerchief and then shakes hands with another person may pass on the infection. Doorknobs, since they are touched by so many people, should be washed frequently. The washing of the hands in hot water and soap before eating would probably do much to reduce disease.

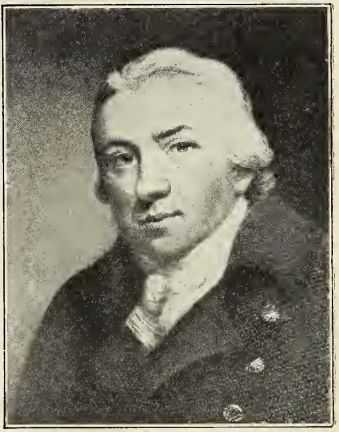
39. Meaning of immunity. When one is frequently exposed to a disease under the most favorable conditions and does not contract it, he is said to be immune. It has been proved that some people are naturally immune to a particular disease. It is also known that immunity is specific rather than general; that is, immunity to one disease does not mean immunity to other diseases. In the case of certain diseases immunity is conferred by having the disease. One does not usually have typhoid, mumps, measles, or chicken pox a second time. This is not true of all diseases. To have pneumonia once, for example, is likely to make a person more susceptible to the disease, which he may have several times. Fortunately most diseases confer a lasting immunity. It was this observation in connection with smallpox which led to vaccination against this disease even before the time of Pasteur.

40. Edward Jenner, friend of mankind. Few of the pupils who study this book have ever seen a case of smallpox, but possibly all of them have seen a person with a badly scarred face. Such disfigurement is the result of the dreaded disease, smallpox. In intelligent communities today smallpox is so rare that some physicians have never seen a case in their practice. About one hundred and fifty years ago it was so common that ten out of every hundred deaths were caused by smallpox. It was found in the hovel and in the palace. During the eighteenth century it is estimated that sixty million people in Europe died from smallpox. In the early part of the eighteenth century it was unusual to meet anybody on the streets of London whose face was not scarred by smallpox. Dr. W. W. Keen says of this period:

If a fugitive from justice had happened never to have had the smallpox, and therefore was not pockmarked, this fact was men-

tioned as a means of identification. Imagine the laughter that such a means of identification would excite today. Today, on the contrary, if he happened to be pockmarked, that fact would be advertised as a means of identification.

Smallpox seems to have originated in India. From there it traveled westward to Europe. The first account of it that we have in the United States was in 1721, when it was reported in Boston. It was brought in by a ship from Barbados. At that time Boston had a population of 10,565. In a few months 5989 persons contracted the disease. With improved transportation and increasing trade it soon spread over nearly all the world.



EDWARD JENNER

He made possible the conquest of smallpox

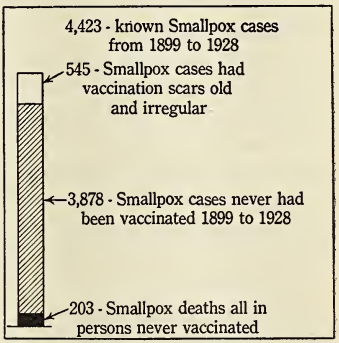
In the eighteenth century a method of lessening the virulence of smallpox came in by way of the Orient, where it had been practiced for many centuries. It was the method of inoculation. Smallpox was so common there, and so few escaped, that the Orientals decided that if they must have the disease, they would have it when it suited their convenience. It became the custom to take a tiny bit of matter from a pustule of one suffering from the disease and insert it under the skin of a healthy person. This inoculation resulted in the actual

disease, but it was usually in a milder form, and there were fewer fatalities. Inoculation against the disease was common in China, India, Persia, Greece, and Turkey. This method was finally introduced into England by Lady Mary Wortley Montagu, the wife of the British ambassador at the Ottoman court. Inoculation against smallpox continued until it was finally prohibited by Parliament in 1840. Although inoculation was fairly successful, those inoculated really had the disease, and sometimes it took on a virulent form and started an epidemic. At a time when this dissatisfaction was evident a new protection against smallpox was discovered. The man who made it possible for smallpox to be banished from the earth was Edward Jenner.

Edward Jenner was a wide-awake physician in Gloucestershire, England. As was the custom, he inoculated many persons for smallpox. It happened that Gloucestershire was a dairy country and that from time to time there appeared among the cows a disease known as cowpox, marked by the appearance of pustules on the udders. Often milkers with slight abrasions of the skin contracted this disease. Pustules developed on their fingers and hands. It was quite generally known among doctors at the time that those who had had cowpox failed to have smallpox when they were inoculated. Jenner was not the first to observe this, but he was the first to investigate scientifically the relation between these two diseases. On May 14, 1796 — a great day in the history of medicine —he took some matter from a cowpox sore on the hand of a dairymaid and with it he inoculated James Phipps, a healthy boy about eight years of age. A single pustule formed, which rapidly formed a scab and dried up, leaving only a scar. Six weeks later, and again several months

later, the boy was inoculated with smallpox from matter taken from a smallpox patient. No sign of smallpox followed. This method of protection against smallpox was called vaccination (from the Latin *vacca*, "cow").

Vaccination was soon practiced all over the civilized world. Napoleon, quick to see its advantage in keeping his armies in fighting condition, ordered that all his soldiers who had not had smallpox should be vaccinated. Thomas Jefferson had his own family vaccinated and also recommended it to others. Spain sent ships to all her dominions carrying physicians and vaccine.


4,423 - known Smallpox cases from 1899 to 1928
545 - Smallpox cases had vaccination scars old and irregular
3,878 - Smallpox cases never had been vaccinated 1899 to 1928
203 - Smallpox deaths all in persons never vaccinated

CHICAGO'S EXPERIENCE

Study this graph. Notice that no person who was vaccinated died of smallpox

Today the greatest care is exercised in the preparation of vaccines. It is never taken from a smallpox patient, but from a perfectly healthy calf. Every precaution known to medicine is taken to insure cleanliness and the quantity and quality of the vaccine.

Vaccination was such a success that in 1802 Parliament voted Jenner ten thousand pounds. In 1806 he received twenty thousand pounds as a token of a nation's gratitude. Although at times he was bitterly attacked, honors continued to be paid to him even after his death. Only recently a small fishing town in Japan, ravaged by smallpox which was finally brought under control by vaccination, erected a monument to him.

Nothing in medical science is more certain than the fact that vaccination prevents smallpox. In those countries where vaccination is common, smallpox has almost entirely disappeared. The community that neglects vaccination is a fertile field for the disease. For safety, people should be vaccinated about every six years. In every epidemic of smallpox those that have been successfully vaccinated against the disease escape. Because of considerable opposition to vaccination, the United States unfortunately exceeds most of the civilized nations of the world in the annual number of smallpox cases.

41. Immunity explained. The fact that persons might be immune to particular diseases was known and made use of before it could be explained scientifically. The work of Pasteur and the distinguished investigators who followed him have now told us much about the way in which the body protects itself.

Disease germs that find entrance into the body eventually find their way into the blood stream. Here they may be attacked by the white corpuscles. Under the microscope these little bodies look very much like the microscopic amebas frequently found in stagnant water. They change their shape readily, and easily make their way through the tissues. They seem to have a keen appetite for germs that are harmful to the body. One of the most brilliant observations with the microscope was the discovery that these white corpuscles eat disease germs. The pus, or matter, which sometimes collects when we run a sliver into our finger is made up largely of dead white corpuscles. They have lost their lives while defending the body against the foreign enemy which has entered through the break in the skin. As the body overcomes a germ disease the number of corpuscles steadily increases.

The second method of attacking the invading microbes is through the antibodies. These are substances which cannot be seen under the microscope or identified by chemical tests. They are in the liquid part of the blood and aid powerfully in overcoming disease. They may kill or dissolve the bacteria or help the white corpuscles to destroy them. There are several different kinds of antibodies. The class of antibodies most commonly heard of are the antitoxins. They neutralize the poisons (toxins) which the bacteria manufacture.

In the light of such knowledge we understand better how disease is overcome and how immunity against it is established. An illness of bacterial origin will continue until so many antibodies have been produced that, with the white corpuscles, they can overcome the disease. The antibodies are usually produced in excess quantities and may be found in the body for a long time after the illness. As long as such a condition persists there is immunity. One is said to be naturally immune if his body already contains enough of the immune substances. In many cases it is probable that the person had the disease in such a light form that it was not detected, and yet immunity was established.

42. Artificial immunity. One way of overcoming disease or preventing it is to stimulate the blood to produce antibodies by inoculation with live germs. This was the method employed by Pasteur in his work against anthrax and hydrophobia. This was also the method employed against smallpox by Jenner. Cowpox is doubtless a modified form of smallpox. It leads the blood to produce antibodies and so establishes immunity.

Weakened but living germs may be used to produce immunity, or dead germs with their toxins may be used,

as in the case of typhoid fever. The toxin of typhoid stimulates the blood to produce antibodies. Typhoid fever has always been the curse of armies. During the Spanish-American War, before typhoid vaccine had been discovered, more men were lost through typhoid than fell in battle. During the World War, when our soldiers were made immune against it, typhoid was almost unknown.

BALTO
Hero of the thrilling Alaska death race

Another way to combat disease is to inject into the body antitoxin produced by animals. This method was used successfully with diphtheria.

The value of diphtheria antitoxin was recently brought to the attention of the public by a threatened epidemic at Nome, Alaska. The nearest help was nearly a thousand miles away in the town of Anchorage, where there was a supply of diphtheria antitoxin. Nome had no antitoxin. The physician at Anchorage dispatched a supply by Gunnar Kassen with his team of dogs. Ordinarily it took fourteen or fifteen days to make the trip. The relief of Nome was one of the spectacular events in the history of medicine. Day after day people at their breakfast tables eagerly read the morning paper to find out whether Kassen and his dogs had arrived. The ther-

mometer fell to 50 degrees F. below zero, but the dogs, trained to exposure and cold, sped on. For speed every known sledge-dog record was broken. The regular fourteen-day trip was cut to five. Nome was saved!

The *Atlanta Journal* published a poem by Alice Rogers Hager on Balto, the leader of the swiftest dog team, which began thus:

Men and dogs on the Arctic trail,
Fighting the blizzard home,
Blind and dumb in the roaring ice,
Breaking the road to Nome:

For sick lips cried that they might be spared,
And white men dared to go,
Out through the din and the thundering night,
Out through the wind-whipped snow.

Continuing the story the poet closes with

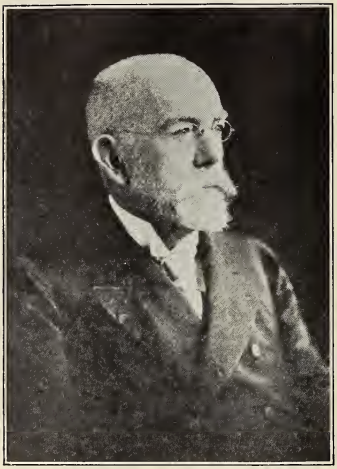
Men have circled the circling earth,
Laughing at air and foam —
But tell of a greater tale than this:
Balto, who went to Nome.

Many who read this dramatic story thought not merely of the dogs and their driver but also of the patient experimenters in the laboratories, working at first hand with dangerous microbes, who had made such heroism worth while.

43. The battle against tuberculosis: Koch and Trudeau. While Pasteur was absorbed in his many experiments, an unknown country physician was practicing medicine among the villages of Prussia. His name was Robert Koch. He found this practice uninteresting and even discouraging at times, because so little was known about the causes of disease.

LIBRARY OF THE UNIVERSITY OF ALBERTA

When he was twenty-eight his wife presented him with a microscope, probably in the hope that he might find its manipulation recreative. He began at first, like Leeuwenhoek, to look at everything around him in a hit-and-miss fashion, but soon he became fascinated by the study of microbes. The hunt became so absorbingly interesting that he became very absent-minded, forgot his wife, and even forgot to call on his patients. It would be too long a story to tell about all the wonderful things he did, but he gained his greatest fame as the discoverer of the bacillus of tuberculosis. After he made the discovery he did not rush at once into print, but verified it again and again by many careful tests. People of all lands were thrilled by the news that this assassin had been discovered. The obscure country doctor with his crude homemade laboratory had beaten out the greatest scientists. The scientific world bowed down to him. He aroused a hope that an effective antitoxin might be prepared to combat tuberculosis, but this hope has not yet been realized. Other heroes, inspired by his zeal, have fought the disease with marked success.



ROBERT KOCH

A distinguished German scientist. He discovered the bacillus of tuberculosis

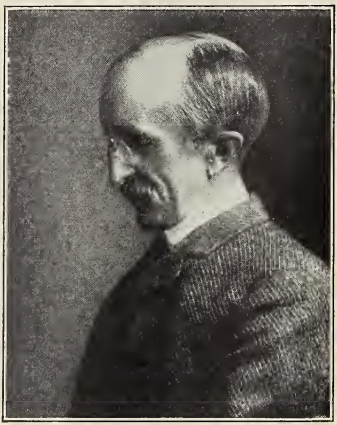
Among the many men who were thrilled by the great discovery of Koch was Dr. Edward Livingston Trudeau in distant America. His life was an inspiration not only to America but to the world. Trudeau was born in New York in 1848. Both his father and his grandfather were physicians. Like many young men he was anxious to succeed. Just as he was about to enter the United States Naval Academy his brother developed tuberculosis. Trudeau was very fond of his brother and returned to his grandfather's house to nurse him. At that time nobody thought that tuberculosis could be cured. Trudeau occupied the same room with his brother and tried to cheer him through his long days of fever and illness. The physician in charge never cautioned him against catching the disease. The physician "told me repeatedly," said Trudeau, "never to open the windows, as it would aggravate the cough; and I never did until toward the end my brother was so short of breath that he asked for air." How strange this story seems in the light of Trudeau's discoveries.

After his brother's death Trudeau studied medicine, married, and returned to New York to practice his profession. It was then discovered that he had tuberculosis in his left lung.

How dark the world seemed! And my rose-colored dreams of achievement and professional success in New York! They were all shattered now, and in their place only exile and the inevitable end remained.

The memories of the many happy days that he had spent in the woods and mountains came back to him, and he set out for the Adirondacks and lived for some time at a hunting lodge. The rest, good food, sleep, and fresh

air after a time made him feel better. His fever left him, his appetite became keen, and he gained rapidly in weight. Later he found a house at Saranac Lake, where he lived the remainder of his life. Dr. Loomis, who examined Dr. Trudeau, found him much improved and began to send to him other tuberculosis invalids. As he recovered Trudeau began to practice his profession and take a keen interest in life. He was so kind and sympathetic with the people of the region that he became known as the "beloved physician."



EDWARD LIVINGSTON TRUDEAU

The beloved physician. He proved that tuberculosis could be cured. His autobiography is a wonderful literary production

Finally the idea came to him of building a sanatorium for tuberculosis patients at Saranac Lake. When he went to New York he called upon people who, he thought, might give to such an enterprise. He found it hard work, because people argued that tuberculosis was incurable. Finally he was able to build the sanatorium, which became famous throughout the country and served as a model for hundreds of other sanatoriums.

He was in the midst of building his sanatorium when he learned of Koch's discovery of the tubercle bacillus. He rushed to New York to find out how to find and study the

bacillus. Next he fitted out for himself a laboratory at Saranac Lake, where he worked for many years, hoping to find a way to kill the bacillus in man. He did not find what he was looking for, but he did make a famous experiment with rabbits which every boy and girl ought to know about.

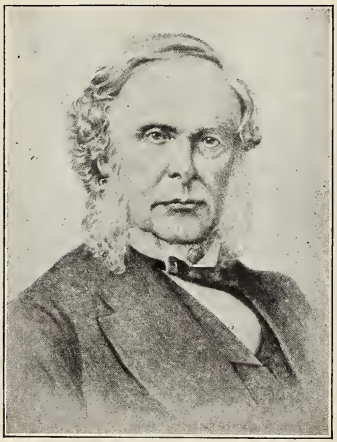
Trudeau experimented on three groups of five rabbits each. Lot 1 was inoculated with a pure culture of tuberculosis and put in a very favorable environment with reference to food, light, and air. Lot 2 was inoculated in a similar way but put into the worst conditions that Dr. Trudeau could devise. Lot 3 was not inoculated, but was also put in a very bad environment. The five rabbits of Lot 1 were allowed to run wild during the summer in the sunshine and air. All but one recovered. Of Lot 2 only one survived at the end of three months and the microscope showed extensive tuberculosis. Those of Lot 3, though very thin, showed no signs of tuberculosis.

This experiment showed that a bad environment alone would not produce the disease unless germs were present. It also showed that after the disease had begun, a favorable environment as to food, sun, and air did much to counteract the disease. This experiment did much to encourage Trudeau to go on with the sanatorium treatment. By such simple methods of treatment thousands of lives have been saved. Trudeau proved that the disease can be arrested if not cured.

The death rate from tuberculosis is rapidly declining, and sometime we may hope to find it a rare disease.

44. Lister, founder of modern surgery. In the history of surgery the name of Lister leads all others, because he applied the discoveries of Pasteur to this science and brought about a revolution in surgical practice. About

the time of the American Civil War Lister was recognized as one of the prominent surgeons of Scotland. At that time hospitals were in a horrible condition. The use of ether and chloroform had now become common, thus banishing many of the discomforts and dangers of surgery, but after operations there was a dreadful loss of life due to frightful infections. Every wound discharged pus freely. This was thought to be a natural and necessary stage in the healing of a wound.



JOSEPH LISTER

The prince of surgeons. His brilliant achievements made the world his debtor

In the light of present-day surgery the hospitals of that day seem indescribably filthy. Surgeons took no special pains to keep their instruments clean. Often they wore the same coat in performing operations day after day. No special care was given to keeping the wounds clean. Little wonder, then, that most hospital surgeons at that time were content to lose from one third to one half of their amputation cases. Many able surgeons at that time seemed to think that to get rid of the hospital diseases it was necessary to demolish the hospitals.

At this time Lister became interested in Pasteur's experiments on fermentation and putrefaction. He became

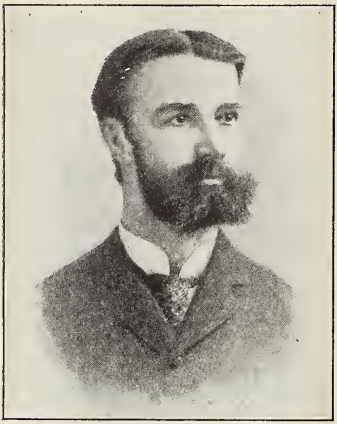
convinced that decomposition was due to minute organisms and that this might be avoided by applying some kind of dressing to destroy these organisms. He began to experiment with carbolic acid and, after some failures, was successful. His ward in the Glasgow Royal Infirmary now became the healthiest one in the world. Lister spent much of his life in converting the rest of the world to his methods. He made hospitals safe places instead of centers of infection, mortality rapidly decreased, and many operations were performed safely that before were pronounced absolutely fatal.

Every modern hospital today is in a sense a monument to the intelligence and skill of Joseph Lister. Surgery today is aseptic (without infection). Before operation the part to be operated upon is sterilized with alcohol. The bandages, instruments, and everything that comes in contact with the wound are aseptic. The physician wears a mask so that there will be no danger of infecting the wound by coughing, sneezing, or breathing. He wears rubber gloves that have also been soaked in an antiseptic (something which kills germs). As a result operations for appendicitis and other maladies are performed today with almost no danger.

During his life Lister received many honors. In 1883 he was made a baron by the crown. He was greatly honored by various scientific societies. In 1902 there was a celebration in honor of the fiftieth anniversary of his entrance into the medical profession. The American ambassador, Thomas Bayard, addressing the great surgeon, said: "My lord, it is not a profession, it is not a nation, it is humanity itself which with uncovered head salutes you."

45. Theobald Smith's great discovery. Although scientists finally came to believe that contagious disease was

due to germs, it was a long and dangerous hunt to discover how some of these diseases were transferred from one person to another. It was Dr. Theobald Smith, an American, who, by exploring a new field, gave the clue to the solution of many mysteries about the transfer of disease.



THEOBALD SMITH

Profound student of insects. He proved that insects might carry disease, and thereby opened up a new field in preventive medicine

Dr. Smith was a member of the staff of the Bureau of Animal Industry at Washington. In 1888 he was called upon to solve the problem of Texas fever, a malady which threatened to wipe out the cattle in the Southern states. There was an opinion among the stockmen that the disease was due to ticks. Scientists laughed at the idea, but Smith decided to try an experiment. Seven cows infested with thousands of ticks were sent from the heart of the Texas-fever country to the North. In field Number 1 four of the Southern cows were confined with six healthy Northern cows. Into field Number 2 they put four healthy Northern cows and three cows from the fever-infected South. But before these cows were put into the field, Smith, with his assistants, picked from them with the greatest care all the ticks. The healthy cows fenced in with the tick-infested cows

in field Number 1 eventually sickened and died; all the healthy cows in field Number 2 remained healthy. Smith made such a careful study of these ticks and performed so many experiments that he finally proved that the Texas fever was carried from sick animals to well ones by ticks. By dipping the cattle to destroy the ticks the disease was almost entirely exterminated. So it was that Theobald Smith gave to humanity a new and fantastic idea of how disease may be carried, — by an insect. Following this cue, it was possible for man to smite some of the most deadly diseases known.

46. Conquest of malaria. One of the first criminals to be discovered in the insect world was the mosquito. His conviction of crime came through a series of brilliant investigations.

Malaria had always been one of the pests of mankind. It was invariably found in damp, swampy places. It was thought by many that the disease was due to a marsh vapor. In 1880 a French army surgeon discovered the microbe that caused malaria in the blood of malarial patients. Even after this discovery it was a mystery as to how the disease could be communicated from the sick to those who were well. It took twenty years to prove that a mosquito was the real offender.

In 1900 an experiment was carried on in the Roman Campagna, — a region notorious for its malaria. A number of volunteers lived in this region in houses that were carefully screened against mosquitoes. When they went out in the evening they were particular to wear veils and gloves. They lived in this way from July until October (the most dangerous part of the year) without contracting malaria, although many of their neighbors who did not take the same precautions had the disease. It was dis-

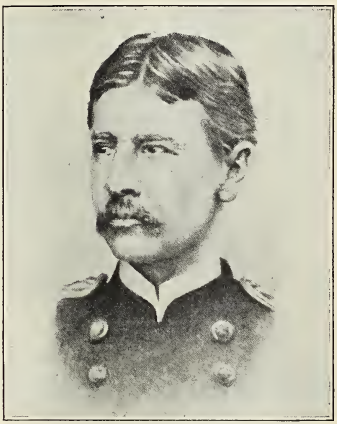
covered that there were places in Italy where there were many mosquitoes but no malaria. It was also discovered that in those places where there was malaria there were always mosquitoes. As a result of careful study scientists discovered that a particular kind of mosquito, the *Anopheles*, was responsible for the disease.

At the same time that the above experiment was being carried on, another dramatic incident in science was being staged. Some mosquitoes were caught and allowed to bite malarial patients. They were then shipped to England. Here two young men who had never had the disease and lived in a region where it did not exist allowed themselves to be stung by these mosquitoes. In a few days both of them came down with malaria. Such experiments showed that the *Anopheles* mosquitoes and not marsh air were responsible for the disease. The most common mosquitoes are the *Culex*, which are troublesome but harmless.

Today malaria has disappeared from those sections where people protect themselves against mosquitoes. This may be accomplished by preventing them from breeding, — by draining swamps, filling in low-lying spots, screening tanks and cisterns, and oiling puddles which cannot be readily drained. The oil forms a film over the water, which prevents the larvæ of the mosquitoes from breathing. Houses need to be carefully screened. At one of the towns on the Suez Canal where Ronald Ross took charge of the war on the *Anopheles*, the number of cases of malaria was reduced from 1551 in 1902 to 37 (all of which were cases of relapse) in 1905.

47. Walter Reed, American health hero. The story of Walter Reed, an American army surgeon, and his gallant companions is one of the brightest pages in American history.

In 1900 yellow fever broke out among the American troops in Cuba. Reed was made chairman of an army board, composed of Carroll, Lazear, Agramonte, and himself, to find the cause of the disease. The American army was almost useless at this time because of the ravages of this disease. Gorgas, who was in control of sanitation at Havana, had made it one of the cleanest cities in the world. In spite of this the disease was even more prevalent than it had been for several years.



WALTER REED

Leader of the group who proved that a mosquito carries yellow fever. (By courtesy of The Century Co.)

Reed suspected the mosquito, and soon began experiments to test the theory. This was tried out by members of the commission themselves, who took their lives in their own hands. Carroll allowed himself to be bitten by a dangerous mosquito that had fed on four cases of yellow fever. In due time he came down with yellow fever. About the same time Lazear, while working among yellow-fever patients, noticed a mosquito biting his hand. He allowed him to take his fill and later fell ill with yellow fever and died. Such experiences, while they suggested the agency of mosquitoes, were not entirely conclusive. Under the direction of Reed a quarantined camp was

established, named Camp Lazear in honor of Dr. Lazear. It was made known that volunteers were wanted for experimental purposes. The announcement was scarcely made before Kissinger, a private, and Moran, a clerk, appeared before Reed and offered themselves for the experiment. Dr. Reed told them of the possible dangers that they ran. "We know," they said. "We volunteer solely for the cause of humanity and the interests of science." Then Dr. Reed told them of the possibility of a reward of several hundred dollars. "The one condition under which we volunteer," they said, "is that we get no compensation for it."

JOHN R. KISSINGER

One of the world's great heroes. He was one of the first volunteers in the experiment which proved scientifically that human beings could get yellow fever through the bite of a mosquito

Walter Reed's hand was lifted to the tip of his cap (for he was a major) as he said, "Gentlemen, I salute you." Kissinger, after having been bitten by several mosquitoes infected with yellow fever, was the first to get the disease under experimental conditions. He returned home in ill health. Americans have been slow to recognize his great service. Later Moran came down with the disease. Speak-

ing of the offer of these men Dr. Reed said, "In my opinion this exhibition of moral courage has never been surpassed in the annals of the army of the United States."

As a result of a number of experiments it was proved beyond doubt that a particular mosquito, the *Stegomyia*, carried yellow fever. Experiments also showed that the disease could not be transferred by soiled clothes or bed linen, for one group of men who had been carefully screened against mosquitoes but who had used blankets, sheets, and pajamas that had been soiled by yellow-fever patients, were in perfect health. Men in the next room, separated from the others by only a screen partition but exposed to infected mosquitoes, had the disease.

THE MALARIAL MOSQUITO

The one at the right is a male; the other is a female[1]

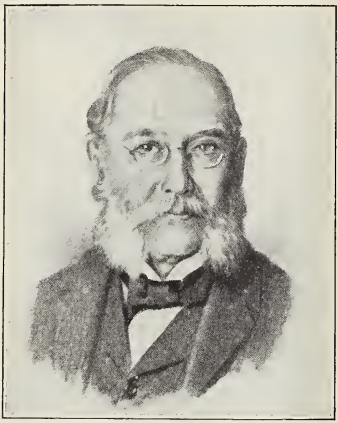
The mosquito was convicted. Well might Walter Reed write to his wife on New Year's Eve that his prayer that he might do something to alleviate human suffering had been answered. "Hark!" he wrote. "There go twenty-four buglers in concert, all sounding taps for the old year."

The practical lesson was clear. To find protection against the bite of the *Stegomyia*, or, better still, to destroy him, meant the destruction of yellow fever. The relentless warfare against him has made yellow fever a very rare disease. It made Cuba a safe place to live in, enabled Americans to build the Panama Canal, and made possible trade and travel in what were once death-stricken regions.

So science works for the welfare of humanity.

[1] From Caldwell and Eikenberry's "Elements of General Science."

48. Warfare against other insects. Typhus fever is known as one of the great epidemic diseases. It is always worst in conditions of filth and overcrowding. This was easily explained later, when it was discovered that body lice spread the disease. The control of the disease was found to be quite simple after the cause was known. It is necessary to avoid being bitten by the louse. Since the louse attaches itself almost entirely to the underwear, and since both it and the eggs may be killed by boiling water, cleanliness is essential. One should also avoid hotels and rooming places that are likely to be infested with lice. During the World War typhus and trench fever (also spread by body lice) were prevented by frequently delousing the soldiers.



CARLOS FINLAY OF HAVANA

Who first suggested the theory that the mosquito transmitted yellow fever. (By courtesy of The Century Co.)

The common house fly is frequently called the typhoid fly, although it may be responsible for the spread of other infections. The fly seems peculiarly adapted to spread disease. First of all, the eggs of flies are deposited in filth, and in this they begin their lives. Then they have most disgusting habits of crawling over garbage and filth. Since the feet of flies are hairy, the flies are well fitted to carry this. Thus they can easily contaminate food.

The way to combat the fly is to prevent its breeding. Since flies frequently breed in manure, this should be screened or disinfected with borax or chloride of lime, and as the flies breed very fast, it is desirable to kill the early ones. Something can be done toward this by swatting and by using poison. Food should be protected by screens. The careful screening of houses effectively protects many homes today. One should avoid restaurants and public eating places where flies are common.

HIDEYO NOGUCHI

Famous Japanese scientist who died on the west coast of Africa in an attempt to identify the germ of yellow fever — a heroic martyr in a great cause

After the work of men like Theobald Smith and Walter Reed, all insects were suspected of having something to do with the carrying of disease.

The bubonic plague, known in history as the Black Death, which has been so destructive of life, was proved to be a disease among rats. It was discovered that the plague was transferred among the rats by fleas that bit sick rats and sucked their blood, and later bit other rats. When fleas left diseased rats and bit human beings, they too developed the plague. The way to deal with this danger is to destroy rats and fleas. Many health departments today employ professional rat catchers to destroy rats. Clubs and organizations have

campaigns to kill them. Some states even offer a bounty for killing rats. When a ship comes from an infected port, it is thoroughly fumigated to kill rats and fleas, and special devices are used on anchors and chains to prevent the rats from getting to shore.

Every householder should have buildings with foundations of stone, brick, or cement. Rats will not trouble people if they are careful to protect all grain, food, and garbage. If for any reason they do become a nuisance, traps should be set for them. Outside of matters of health it is desirable to get rid of rats because they destroy property.

A RAT FLEA, HIGHLY MAGNIFIED

It may carry plague. Prevention of this disease demands the destruction of rats

49. What the health knights contributed. Let us now try to enumerate some of the most important points in this chapter, especially the achievements of the health knights in their courageous battle against disease.

1. In ancient times the cause of disease was unknown. It was thought to be due to evil demons, peculiar movements of heavenly bodies, or other unreasonable causes.
2. Even in ancient times men discovered through experience certain things about health and disease.
3. The discovery of the cause of communicable diseases had to wait until the microscope was discovered and microbes, or germs, were seen.
4. Leeuwenhoek, an unschooled and in some ways ignorant man, developed the microscope and discovered the first germs, or microbes, but he regarded them simply as curiosities. We now know that they are very tiny plants and animals, and that they reproduce themselves by dividing. They grow very rapidly.

5. Pasteur, the brilliant French scientist, laid the foundation for a new science, bacteriology. He discovered that bacteria threatened the silk and stock-raising industries in France, and found a way to save these industries. He showed how hydrophobia might be prevented. He proved that microbes were the cause of communicable diseases.
6. Through the researches of Pasteur and others we have discovered that germs make a poison, called toxin, and that our blood protects us by producing antibodies, particularly antitoxin. Some diseases, like diphtheria, may be prevented by injecting into the circulation of persons diphtheria antitoxin which has been manufactured in the blood of animals. The injection of dead germs, as in the case of typhoid, will stimulate the blood to produce antitoxin.
7. To prevent disease it is well to avoid people who are ill and to prevent the entrance of germs into the body.
8. The discovery of vaccination by Edward Jenner made the prevention of smallpox possible.
9. Koch discovered the germ of tuberculosis, and Trudeau showed that the disease might be prevented or arrested by good health habits.
10. Lister made use of some of the truths discovered by Pasteur and revolutionized conditions in hospitals.
11. Theobald Smith helped to open a new chapter in the prevention of disease by showing that insects may carry disease.
12. Through the discoveries of men like Sir Ronald Ross and Walter Reed malaria and yellow fever have almost entirely disappeared.
13. The rat flea is responsible for bubonic plague, and body lice are responsible for typhus.
14. The health heroes have done much for humanity. They have given us splendid examples of courage. If we follow their teaching, we may expect to live longer and be of greater service to the world.

Try This

Write a brief statement about each of the following. Think hard. Do your best.

1. How illness challenged man.
2. The contribution of Leeuwenhoek to science.
3. The kind of life to which microbes belong.
4. The theory of spontaneous generation.
5. The contribution of Spallanzani to science.
6. The way microbes reproduce themselves.
7. Pasteur as a man.
8. Pasteur's contributions to science.
9. Microbes as friends of man.
10. How vicious microbes invade the body.
11. How we may become immune.
12. The contribution of Edward Jenner to science.
13. Smallpox before the time of Edward Jenner.
14. The story of Balto.
15. The discoverer of the bacillus of tuberculosis.
16. How Trudeau recovered from tuberculosis.
17. Trudeau's experiments.
18. The founder of modern surgery.
19. The contribution of Theobald Smith to science.
20. The cause of malaria.
21. The fight against typhoid.
22. The fight against the fly.
23. The fight against the rat.
24. How the individual may protect himself against disease.
25. What my community is doing for the health of its people.

Interesting Things to Do

1. Explain to the class how a microscope works.

2. Write a play in which Leeuwenhoek or some other scientist mentioned in this chapter is the hero.

3. Report to the class additional facts about the lives of Pasteur, Trudeau, and other health heroes mentioned in this chapter.

4. Write a composition on how scientists test their conclusions.

5. Appoint a committee to visit your city (or county) health officer and report to the class on the ways in which your community is protected against disease.

6. Draw a large map of your city or township. Assign each block or division of it to two pupils. Have them report on breeding places of flies, mosquitoes, and rats. Make a different-colored spot on the map for each kind of danger.

Red: uncovered garbage pails
Black: unscreened outdoor toilets
Green: manure heaps
Blue: standing water
Orange: dump heaps

Then decide what to do about it.

7. Ask the city (or county) health officer to show you records of communicable diseases of the past year. Make another spot map, with a different color for each disease. See if there seems to be any connection between the spots on each map. Explain why there is not, or why there is.

8. Appoint two pupils to visit each place in town where food is sold and report on the cleanness and on the protection of foods from dust, from animals, and from handling.

CHAPTER IV

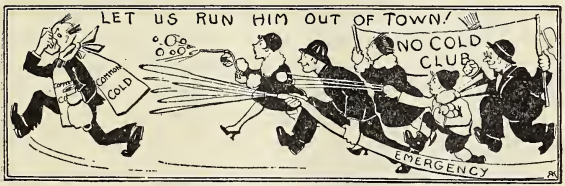
THE CAUSE, PREVENTION, AND CURE OF COLDS

50. The menace of colds. A common expression is, "It's only a cold"; but colds are not to be treated so lightly. They are one of the pests of humanity. More people suffer from colds than from any other single ailment. Nearly everybody, in the course of a year, has one or more colds. The vast majority of colds do not prove to be serious, yet any cold leads to discomfort and may lead to financial loss and severe physical suffering. Business concerns find that colds among their employees are often a serious handicap to success. As a single cause of absences colds usually head the list in both business and schools. The so-called common cold, if it is not cared for, may develop into such serious maladies as pneumonia, pleurisy, and other infections. In spite of the frequency of colds, and their seriousness, medical science has made less headway against them than it has against typhoid and many other diseases.

51. Colds caused by bacteria. Common colds are caused primarily by bacteria. Instead of one kind of germ that is responsible, there are so many that medical science so far has not succeeded in identifying and cataloguing them. Most colds start high up in the throat and then spread into the nasal cavity. A cold may spread to the throat and lungs. The symptoms of a cold are so common that they require no description. The most common symptoms are dryness of the throat, burning of the eyes, a nasal dis-

charge, and a feeling akin to fatigue. A severe attack is usually accompanied by chills and fever. It should be remembered that colds are communicable.

Various names are given to colds, according to the location of the infection. A cold in the head is called rhinitis; an infection which covers substantially all the throat is pharyngitis; if confined to the tonsils, it is known as tonsilitis; when it attacks the tubes of the lungs, it is



WILL YOU LEND A HAND?

called bronchitis, and when it reaches the cells of the lungs it is pneumonia, one of the most serious colds.

The ordinary cold is not so serious in itself, but it may lead to complications of a very serious nature. Colds are now considered one of the secondary causes of heart trouble and rheumatism.

52. How to treat a cold. The time to begin to treat a cold is as soon as one feels it approach. The following suggestions represent the general consensus of reliable opinion as to the best methods of dealing with colds:

1. *Get more rest and sleep.* This is quite essential, so that the body may be in a good condition to fight the cold. In such a case it is a wise plan to cancel engagements so far as possible and retire early. This should be accompanied by a diminution of work. Unfortunately in many cases people get the idea that to adopt such a

method would mean "babying one's self," which would be disgraceful and unnecessary. As a result the cold may get worse and hang on for a long period of time, often forcing the person to abandon his work and take to his bed.

2. *Rid the body of poisons as speedily as possible.* Catching a cold means that the bacteria which have invaded the body are manufacturing poison which, if allowed to remain in the system, may do serious damage. The body gets rid of its poisons, or excretes, through four different channels — the lungs, bowels, kidneys, and skin. All these channels should be kept open. Ordinary breathing eliminates some of the poison. The bowels should always be kept open. Ordinarily a mild cathartic is necessary. Drinking generous amounts of water is to be recommended, since this enables the kidneys to throw off poison readily.

   One of the most popular treatments is to make the patient sweat. It is to be recommended. The old-fashioned remedies that have proved effective are to take a hot bath or a foot bath, which should continue for from ten to twenty minutes, before the patient retires. He should then take a hot drink, such as hot lemonade, and go to bed with extra covering over him. The heating of the body tends to relieve the congestion of blood, restore the circulation to a normal condition, and get rid of poison. This is so effective that sometimes the person who retires at night with all the symptoms of a cold rises the next morning feeling perfectly well. The sweat treatment is to be undertaken only after the liberal drinking of liquids; otherwise the treatment would do more harm than good. Ordinarily the hot bath is effective only during the first stages of a cold. It is to be avoided when there is a temperature.

3. *Eat lightly.* This relieves the strain on the digestive system. In mild colds the matter of diet is not so important. In severe colds accompanied by fever the diet

should be largely liquids and soft, easily digested food. The food should be simple and nutritious.

4. *If feverish, call your family physician.* This is always wise, since he may prevent serious complications.

53. Prevention of colds. Although the problem of preventing colds is far from being solved as yet, the following suggestions, if carried out, would without doubt greatly lessen the number of colds.

HE DESERVES A JAIL SENTENCE!

1. *Avoid people who have colds.* If we could prevent the entrance of cold germs into the body, there would be no colds. As is well known, they are so contagious that frequently they run through an entire family, school, or office. Colds are most contagious at the beginning. At that time especially, the person with a cold is a menace. Avoid him as much as possible. Coughing and sneezing are ways in which the bacteria are sprayed around. When people become more enlightened as to colds, those suffering from that malady will be promptly isolated, as they are in most contagious diseases. This plan has been adopted in some schools to advantage. The pupil who has running eyes and nose and is coughing and sneezing has no business to be in school infecting others. He should go home and go to bed.
2. *Form habits to avoid contact infection.* Colds, like many other diseases, may be transferred by direct and indirect contact. Habits that should be avoided are kissing, drinking from a common drinking cup, using a roller

towel, and putting fingers, toys, pencils, and other things into the mouth. Washing the hands before eating is especially important. How easy it is to get the hands contaminated. You meet a friend suffering from a cold. Previous to your meeting he has used a moist handkerchief freely. You shake hands. Along with the cordiality of the handshake he passes on the contamination from his hands to yours. Later you touch food or a pencil which is carried to the mouth, and so get your friend's cold.

3. *Avoid being chilled.* Drafts in themselves do not cause colds, but drafts that suddenly cool the body, and exposure to cold that chills, do tend to make one susceptible to colds. Needless exposure to cold is always to be avoided. Colds due to exposure may sometimes be prevented by hot baths, hot drinks, and going to bed early.
4. *Avoid overheated living rooms.* Probably one of the most common causes of colds is the overheating of our homes, business offices, and schoolrooms. Hot, dry air in overheated rooms dries the mucus of the nose and throat, produces irritation, and makes infection easier. The temperature in homes and schools should be about 68 degrees Fahrenheit. It should never exceed 70 degrees.
5. *Adapt your dress to the weather.* Since the temperature in our homes and schoolrooms is likely to be summer heat, the wearing of heavy clothing indoors is not to be recommended. Such bad habits produce discomfort and make the skin sensitive to cold. One should adapt one's self to the outdoor weather by suitable wraps. On cold days one should be adequately clothed with heavy outer garments. Probably inadequate dress when exposed to the cold of street cars and streets is responsible for many colds.
6. *Get plenty of fresh air.* Colds are caught indoors, where people congregate, rather than out of doors. It is not

the engineer in the cab, with his head protruding, looking up and down the track, who has colds. They are reserved for the passengers in the stuffy coaches. Indoor air is likely to be dry, dusty, and contaminated with germs of cold; outdoor air is usually moist and fairly free from dust and bacteria. As soon as windows are opened in the spring, colds begin to disappear; when the windows are closed in the fall, the colds promptly make their appearance. To avoid colds one should spend an hour each day in the open air and sleep with one's windows open.

HEALTH HABITS HELP TO PREVENT AND CURE COLDS

7. *Train your skin to resist changes in temperature by cold baths and vigorous rubbing.* Some people are more susceptible to colds than others, because their skin is sluggish and does not respond well. Their nervous system and muscles act in such a way that the blood leaves the skin too rapidly and returns slowly. This sluggishness can be overcome in part by taking cold baths and giving one's self a vigorous rubbing afterward. The cold plunge bath is to be avoided by most people. The best kind of bath is the cold sponge bath early in the morning. A good way to get used to the shock of the cold sponge bath is to begin in summer. People who are frail or in ill health should not take cold baths without the advice of the physician. In such cases a cold bath tends to reduce the resistance to colds by using up too much energy.
8. *Avoid constipation.* Since constipation involves the collection of poisons in the system, it is a menace to health

and, in the opinion of the best medical authorities, makes one more susceptible to colds. This should be corrected by drinking plenty of water and eating fruits, vegetables, brans, etc. If one has persistent trouble, he should consult a physician.

9. *Choose a normal diet.* Children of junior-high-school age frequently do not eat enough. There should be an abundance of nourishing food and a well-balanced diet. Foods, such as egg yolk and butter, containing vitamin A are especially desirable (see page 202).
10. *Avoid undue fatigue.* There is a good deal of evidence to show that fatigue makes the invasion of cold germs easier. Dr. Russell L. Cecil says that he knows "people who never get cold except when they are in a state of physical exhaustion." When this condition is accompanied by overwork, worry, late hours, and lack of recreation, colds naturally result.
11. *Keep yourself in first-class physical condition.* To avoid colds one should keep himself in good physical condition. Sleep, fresh air, exercise, wholesome recreation, nutritious food, and attention to the other suggestions for personal hygiene mentioned in this book tend to make one healthy and able to resist colds.
12. *If, after following the above suggestions, you are still troubled with colds, consult your physician.* One of the reasons for persistent colds may be foci of infection in the respiratory system. A thorough physical examination by a specialist might show adenoids, enlarged tonsils, or some infection of the ears or sinuses. The correction of such difficulties might involve some minor operation.

Even when a person is in good health and the nose and throat are in excellent condition there may be a susceptibility to colds. This may be due to a lack of proper antitoxin against colds in the blood. In such cases some of the vaccines for colds may be tried. They are still in an

experimental stage but seem to work well with some people. They confer immunity, however, for only a short time. The inoculation must be repeated often.

Try This

Write *Yes* or *No* after each of these statements. Every statement is either true or false. Let the class discuss each statement. How many will you get right?

1. A cold should require no attention.
2. Colds may be the beginning of a serious or even fatal illness.
3. Colds are a common cause of absence among employees.
4. Colds are not catching.
5. A cold in the head is called bronchitis.
6. The best way to cure a cold is to keep at one's regular work.
7. If you have a cold, try to get more sleep.
8. Foods containing vitamin A should be avoided.
9. Colds are spread by coughing and sneezing.
10. Washing the hands is no preventive of colds.
11. Keeping the house too hot is one of the causes of colds.
12. When we close the windows in the fall, colds usually begin.
13. Fatigue has nothing to do with colds.
14. Colds are never serious enough so that one needs to consult a physician.

Interesting Things to Do

Make a campaign against colds in your school or room. Let each pupil absent himself from school promptly with the first signs of a cold and remain out until recovered. Let everybody carry out the suggestions in this chapter. Compare the absences due to illness in your school with those in the same grade in another school.

CHAPTER V

ACCIDENTS: THEIR TREATMENT AND PREVENTION

54. Frequency of accidents. Americans are a very careless people. The number of fatalities due to accidents is, in proportion to the population, twice as great in the United States as in England and Wales. It is to be expected that we should exceed other countries in automobile fatalities, because of the much higher number of automobiles in this country; but more people are fatally injured from such common causes as falls, burns, and street-car and railroad accidents. Our drowning rate is exceeded only by Canada and such distinctly seafaring countries as Scotland, New Zealand, Australia, and Norway. We are often reminded by the press and platform orators of the men lost during the World War; yet the number of accidental fatalities in the United States every year exceeds the number of American lives lost during the entire war. A review of such facts forces us to conclude that we as a people are very careless of life.

55. Most accidents are preventable. It is difficult to determine what percentage of accidents are preventable, but it is generally agreed that the vast majority of them are needless. This has been proved partly by the rapid decrease in accidents in this country since the installation of safety machinery in factories and since the development of safety education. So marked has this decrease been that the saving of life during the past sixteen years

is about five times our loss during the war. The growing interest in accident prevention on the part of schools, railroads, and industrial establishments foreshadows a time when America may be as efficient in preventing accidents as she now is in the use of machinery.

FIFTH AVENUE IN 1900

How many automobiles can you count? (Courtesy of the United States Bureau of Public Roads)

56. Safety education in a junior high school. In many high schools the pupils take a very important part in safety education through clubs and school organizations. An interesting piece of work is going on in Public School No. 30 of Manhattan, New York City. A safety court was installed in this school. Each class appointed safety commissioners who elected a judge, a clerk, and a district attorney. In choosing the judge the teachers select five

boys that they believe to be qualified. From these the commissioners select one.

This court works as follows: The captains in the yard turn over reports on hitching and jaywalking to the teacher in charge of the court. The children involved are

FIFTH AVENUE IN 1925

How many vehicles drawn by horses can you count? (Courtesy of the United States Bureau of Public Roads)

summoned into court. Witnesses are called and decisions are rendered by the judge. The punishments consist of assignments to write poetry on safety, to make safety posters, to make speeches in the yard on safety, etc. Those who do not obey the court are given a double penalty. The court opened in March, 1924, and handled about 140 cases at its first session. By November, 1925, the number had decreased to about 18 at each session.

In addition to the safety court the school has each year a safety exhibit for which each student is expected to contribute a poem, game, or safety idea. Safety bulletins are frequently put on the bulletin board. A topic on safety is required in the upper grades in oral English at least once a week.

57. Everybody needs to be trained to meet emergencies. It is much better to know how to prevent accidents than to be able to treat them. Accidents will occur, however, no matter how hard we may try to prevent them. They happen to everyone. Some of them are trifling and some are serious. The person who is trained so as to know what to do in case of a burn, sprain, cut, or other emergency will often be able to save his own life and the lives of others. For this reason many schools today give training in emergencies and first aid. In the remainder of the chapter the most important measures in regard to safety and emergencies will be discussed.

Wrong Right

HOW MANY REASONS WHY?

58. Safety in crossing streets. The streets today, with their crowded traffic, are more dangerous than an ordinary railroad crossing. Everybody should form the habit of looking to the left and to the right before crossing the street. Watch for cars coming around the corner. When it is safe to cross, go ahead without hesitation. If you

get caught in the traffic, stand perfectly still. If you dodge, the automobile drivers will not know how to steer.

Do not forget to obey the traffic officer. It is his business to look out for your safety.

Cross at the street crossings only. The drivers expect people to cross there. Many accidents are caused by

WATCH THE TRAFFIC OFFICER

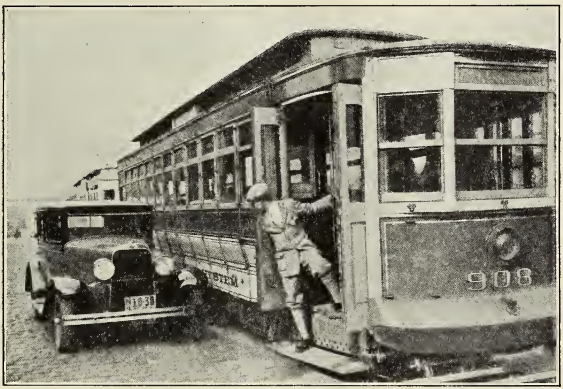
He is there to protect you if you will only let him

people stepping out into the middle of the street from behind a parked car. When you do this you cannot see cars that are coming, and the drivers cannot see you.

Carry your umbrella high. If you hold it low you cannot see the traffic, and also you might injure somebody else's eyes.

59. Be careful in your play. It is not safe to play on the streets. Children should find a vacant lot or go to a regular playground. Many accidents happen in coasting on the streets. If you must coast in the street, take turns with your companions in guarding the street to give

warning of approaching cars. If you ride a bicycle, signal like an automobile driver when you turn a corner. It is not safe to ride on the handlebars, because it hides the traffic from the one on the seat who does the steering. If you find it necessary to chase your hat or ball into the street, look out for automobiles. The loss of a few minutes



WATCH YOUR STEP AND WATCH THE TRAFFIC WHEN YOU GET OFF THE STREET CAR

Such habits would prevent thousands of accidents

is less important than safety. There is a common saying well worth heeding: It is better to be safe than sorry.

60. How to avoid street-car accidents. Most street-car accidents happen in getting on and off the cars. Look back before you get off, to see whether anything is coming. Then face toward the front of the car, holding the handrail with your left hand as you step down. If the car should start suddenly, you will be going in the same way as the car and are less likely to lose your balance.

Automobiles are not usually allowed to pass a car on the side where passengers are getting off. It is therefore better to go directly to the curb and wait for the car to go on if one wishes to cross the street.

61. Prevent falls. Between ten and fifteen thousand people lose their lives by accidental falls each year. With care nearly all falls could be prevented, because most of them are caused by carelessness. Here are some suggestions for the prevention of accidental falls:

1. *Keep everything in its proper place.* After we have finished using tools, clothing, etc., they should be restored to their usual places. Stairways and sidewalks should be kept clear. Many accidents are caused by leaving rugs mussed up or furniture out of place so that people trip or stumble.
2. *Keep rugs and carpets free from holes.* Such holes may catch people's feet and cause them to fall. Especial attention should be paid to the condition of carpet on stairs. High heels may catch on the treads of a staircase. This is another good reason for wearing sensible shoes.
3. *Avoid leaning out of windows or over dangerous places.* Leaning over porches, banisters, and fire escapes should be avoided. When babies are around, it is desirable to screen the windows and install a safety gate at the stairs.
4. *Use a safe stepladder or a good substitute.* All stepladders should have their feet on the ground or floor and the braces set. Do not use a ladder of any kind which needs to be repaired. If a stepladder is not at hand and you must use a chair, take a strong one with a solid seat. Avoid the piano stool or a rocking chair.

62. Watch slippery places. Stepping unexpectedly on slippery places is responsible for many falls. Ashes, salt, or sand should be sprinkled on icy spots. Deposit fruit

peelings in rubbish cans. If other people are negligent, do a good turn as a citizen by picking the peelings up and putting them in a can. If that is not possible, kick them to the gutter, where they will not be likely to do harm. Beware of small rugs on polished floors, particularly if they happen to be near the foot of a stairway. It is surprising to note the number of people who in stepping upon a rug on a polished floor slip and fall.

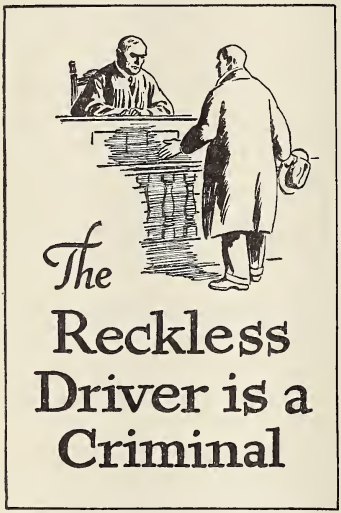
63. Other things to be careful about. It is always a good plan to wait until the car or vehicle stops before getting off or on. Small objects like marbles, gravel, and bits of wood often cause sprained ankles and falls. Look out for them and get rid of them when you see them. Do not go too close to the edge of elevations. The edges may crumble. Open elevator shafts are dangerous. Keep away from them.

64. Prevention of burns. About fifteen thousand people in the United States lose their lives every year from fire. Besides the fatal accidents there are thousands of minor accidents that cause much discomfort and pain. Most burns may be prevented.

The careless use of matches is responsible for many fires and burns. Matches should be kept in earthen or metal containers out of the reach of little children and where rats and mice cannot get to them. Burnt matches should never be thrown into a wastebasket, even when you believe that they are out. Use a flashlight or a safe lantern rather than a lighted match when you are searching for something in a closet.

If lamps are used, they should be filled during the day and away from a flame. One should never look for a leak in a gas pipe with a lighted match. Notice in your newspaper the number of accidents caused in this way.

Many fires are caused by the careless use of stoves and open fires. Oil stoves should be filled during the day and kept very clean. Stoves and furnaces should be regulated so that they will not get red hot. A gas stove or heater should not be connected with cheap rubber hose. Flexible metal tubing is safer. A stove or heater should be placed on zinc, asbestos, or cement. Loose paper should not be thrown on an open fire. The pieces of burning paper may be blown up the chimney and set fire to the roof or a neighboring building. Rolls of paper should be weighted down with a piece of wood, as they may unroll while burning.



WHAT PROTECTION HAVE YOU AGAINST RECKLESS DRIVING IN YOUR COMMUNITY?

Carelessness in building bonfires, in disposing of ashes, oily rags, and wastes, and in using gas and electric fixtures, stove polishes, kerosene, gasoline, naphtha, and cleaning fluids is responsible for many fires. Careless smoking is another cause of fires.

65. What to do in case of fire. If your own clothes catch on fire, lie down and roll. Do not run for help, as running will fan the flames. If somebody else gets on fire, get him to lie down, and wrap him tightly in a rug, blanket, or

coat. Begin to wrap near the head, to keep the flames away from the face. Beat out the flames or roll him on the floor.

If you discover a fire in a building, close all doors behind you, so that there will be no draft. If the smoke is very thick, tie a wet cloth or handkerchief around your nose and mouth to protect yourself against the smoke. If this is impossible, creep along on the floor, where the smoke is always thinnest. Remember that very few people lose their lives in burning buildings. Never jump from the window or roof. Keep your head. Wait for the fire department or other help.

66. Care of burns. To treat an ordinary burn it is necessary to exclude the air and apply a nonirritant. Good dressings for slight burns are baking soda dissolved in water, starch or flour, ordinary or carbolated vaseline, olive oil, castor oil, cream, lard, or epsom salts. After applying the dressing, cover the burn with a piece of sterilized gauze and hold it in place by a bandage.

In case of a severe burn a physician should be called. Before the physician arrives the burns may be treated with the dressing noted above. If the clothing sticks to the burn, do not try to pull it off. Cut the cloth around the place and soak it off with castor oil or olive oil.

67. Care of sprains. Sprains are injuries of the joints. They are caused by stretching, twisting, and partial breaking of the ligaments around a joint. The pain is likely to be severe. The best treatment is rest and hot and cold applications. The patient should not move his sprained joint. The injured part should be elevated. The cold application may be crushed ice wrapped in a cloth. Ordinarily it is better to apply cloths wrung out of very hot or cold water. To get the full benefit from the hot or cold

applications they should be used for at least twenty-four or thirty-six hours. In case of a severe sprain a doctor should be summoned.

68. Treatment of nosebleed. Remember not to blow the nose. This prevents the clotting of the blood, which will stop the bleeding. Put a handkerchief over the nose, hold the head back, and take slow, deep breaths. A cold application, such as cold water, cracked ice, or a piece of cold metal, like a key or the blade of a knife, will help. Sometimes a piece of clean folded paper pressed up between the upper lip and the gum will help to stop the bleeding.

HAVE YOU STARTED A CAMPAIGN IN YOUR SCHOOL AGAINST JAYWALKING?

69. Frostbite. The way to prevent frostbites is to wear warm clothing. The parts of the body that are most likely to be frostbitten and need to be protected are the ears, cheeks, nose, fingers, and feet. Rubbing the ears, cheeks, or nose when they begin to feel cold will often prevent frostbite. Any part of the body that is frostbitten turns gray or white. It is important to restore the temperature gradually or pain will result; do not allow the patient to go into a warm room. Rub the affected parts

with snow or cloths wrung out of cold water. If the skin is broken an antiseptic ointment (such as zinc oxide ointment) should be applied. The person who is frostbitten needs to be careful, for some time in the future, about exposure to the cold, as it will be easier to be frostbitten again.

70. Scratches, cuts, and other injuries which break the skin. The skin is a natural protection to the body. It prevents harmful bacteria from entering the body. Even the slightest injury to the skin, such as the scratch of a pin that draws blood, may give trouble if not properly taken care of. Blood poisoning is the name given to the dangerous condition which follows the invasion of deadly germs.

When there is any injury which breaks the skin, it is important to keep the wound clean and to kill any germs that may have gained entrance. Let the wound bleed for a time, as blood will carry off most of the germs. Avoid washing the wound with ordinary water, since the water may be impure. Paint around the wound with tincture of iodine. Cover the wound with sterile gauze. Do not cover the wound with court plaster or cotton batting, since neither of them is sterile. If you cannot find gauze, use a clean handkerchief or towel. Never touch the wound with your hands, as they may not be clean. Wounds received from rusty nails need special care, as such wounds are especially liable to infection.

To remove splinters use tweezers, or put a knife blade against the splinter and then hold it with your thumbnail. Before using a needle to remove a small splinter under the skin, dip it first in boiling water or pass it through a flame. Call a doctor if the splinter is large or deeply imbedded.

It is always best to consult a doctor in case of an animal bite. Squeeze the wound so that it will bleed freely and carry off the germs. Then scrub it with any good soap.

Nature attempts to stop bleeding by clotting. This may be hastened by putting a piece of sterile gauze over the wound. If blood spurts from the wound, it is a sign that an artery has been cut. Under such conditions tie a handkerchief or a bandage loosely on the side next to the heart. Twist it tight with a stick. If the bleeding is severe, call a doctor at once.

71. Poisoning. When a person has swallowed poison, a doctor should be sent for at once. Do not wait for him to arrive before treatment is started. Try to get the entire contents out of the stomach by producing vomiting at once. Running the finger down the throat will often produce vomiting. A teaspoonful of mustard or salt in a glass of water is usually a good emetic. Between the attacks of vomiting, plenty of lukewarm water should be taken. This will dilute the poison in the stomach.

72. Learn how to swim. There are at least two good reasons why every boy and girl should learn to swim: first, swimming is an exhilarating and healthful exercise; second, it may be a means of saving one's own life or the lives of others. Swimmers should ordinarily refrain from staying in the water more than half an hour or from swimming immediately after meals. Even the best swimmers have cramps and sometimes lose their lives. It is foolish to take unusual risks in the water.

73. How to produce artificial respiration. In case of drowning or gas poisoning, life may often be saved by artificial respiration. Breathing is drawing good air into the lungs and forcing bad air out. When for any reason this process is stopped, it may be restored artificially by forcing the

lungs to expand and contract as in normal breathing. This is called artificial respiration.

Brief directions for carrying this out, according to the National Safety Council, are as follows:

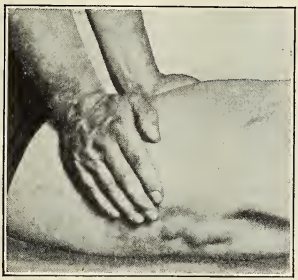
Start treatment immediately and as near the scene of accident as possible.

Lay the victim on stomach, face to one side, arms over head. Now kneel, straddling victim, well below the waist, facing toward head.

STEP 1

In producing artificial respiration first put the patient in this position. Free breathing is now made possible

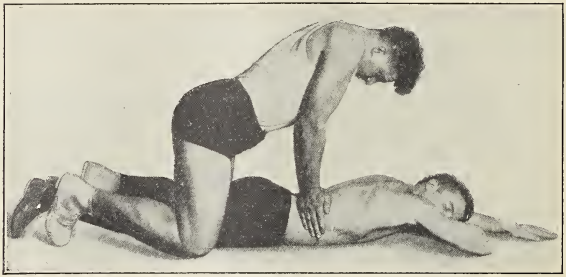
Place your hands on victim's sides, just above hips and touching lowest ribs.



STEP 2

Kneel, straddle patient, and place hands in position indicated

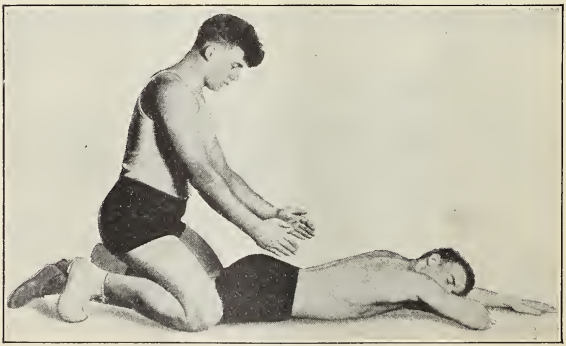
With arms straight, swing forward slowly, bring your weight to bear upon the victim, gradually and heavily but not violently, for about three seconds.



STEP 3

Straighten arms and swing forward, applying weight gradually and heavily but not violently. This forces air out of the lungs

Then swing back to original position, releasing your weight. Repeat operation about twelve times a minute or at the rate you breathe.



STEP 4

Swing arms back, releasing weight. Let air fill the lungs. Repeat all steps

All you do by these operations is to force air out of the lungs when you exert pressure; when you release pressure, the air flows back itself.

The victim will usually show signs of returning life within half an hour, but if he does not, continue as long as two hours.

Do not remove him until he is breathing normally without assistance; then use a stretcher. Keep him warm and in bed for several hours.

74. A safe vacation. The whole nation now goes on a vacation. The summer vacation is the most popular one of the year, but many families take short vacations during the year. The vacation is to be recommended. It brings relief from work and should mean rest and recreation. Unfortunately, in many cases people return from a vacation tired out because of physical strain. Often, too, because of careless living and because of unsanitary conditions, they return ill from serious communicable disease.

The following suggestions will be helpful to those who wish to have a safe vacation:

1. Get a sufficient amount of sleep and rest so that you can enjoy your recreation to the fullest extent, and so that you may return home better fitted for work.
2. Choose clean, sanitary eating and rooming places. Avoid eating places where there are flies or where the attendants seem dirty. Disease is spread by people who are careless in their personal habits.
3. Always carry your personal toilet articles with you. Never use a common towel or anyone else's brush or comb. Provide yourself with paper drinking cups or a drinking cup of your own.
4. Be careful about the water you drink. Never drink from an unprotected spring, from an open well, or from one that is close to an outhouse. If you are in doubt about your drinking-water, boil it or sterilize it.

5. Be careful about your milk supply. If possible, drink only pasteurized milk, handled by clean people. If pasteurized milk is not available, be reasonably assured, possibly by personal investigation, that the milk is produced under sanitary conditions.

6. Be prepared for all accidents and emergencies. A first-aid kit such as may be purchased at the ordinary drug store is desirable.

7. To be vaccinated against smallpox is always desirable, and to be immunized against typhoid is also desirable, since typhoid fever is often contracted by people who visit rural districts.

POISON IVY

Learn to recognize and to avoid this plant

75. Poison ivy. During the months of summer, poisoning from ivy is common. The poison-ivy plant is a creeper, or climbing plant, with pointed leaves, sometimes slightly notched. The leaves are arranged in clusters of three. Nearly everybody who touches this plant is poisoned, and some can hardly be near one of these plants without being poisoned.

Ivy poisoning usually appears on the hands, arms, and face. The skin becomes very much inflamed, and blisters form. There is itching and often considerable pain. When

the poisoning is in its first stages, it may be carried from one part of the body to another by scratching. Many a vacation has been spoiled by ivy poisoning.

It is always a good plan to avoid poison ivy; but if one is poisoned, a simple remedy is to wash the affected parts with a solution of boric acid and then smear on zinc ointment. Make the solution of boric acid so strong that some of it is deposited on the bottom of the basin. Limewater may be used for the wash, and carbolated vaseline for the ointment. The ointment should be washed off daily with the wash, the skin dried, and the ointment again applied.

Try This

Write a brief *important* statement about each of the following. Think hard. Do your best.

1. The frequency of automobile accidents in your town or city.
2. One way in which everybody may help to prevent automobile accidents.
3. What your school is doing for safety.
4. How to cross the street.
5. How to get on and off a street car or bus.
6. Safety in the home.
7. How to prevent burns.
8. What to do in case of fire in your own home.
9. How to care for frostbite.
10. A very important precaution in caring for a wound.
11. The test of a good vacation.
12. The care of poisoning by ivy.

Interesting Things to Do

1. Find out from your druggist whether he carries first-aid kits. What do they contain? How much do they cost? How much cheaper would it be to make up your own kit? Report on these facts to the class.

2. Plan an imaginary vacation trip. Make a booklet. Illustrate it with material taken from time-tables, newspapers, and magazines. Make definite plans as to how to keep healthy.

3. Learn to give artificial respiration.

4. Give the class a three-minute talk on "Safety in Our Own School."

5. Report to the class on what your community is doing for the safety of its children.

CHAPTER VI

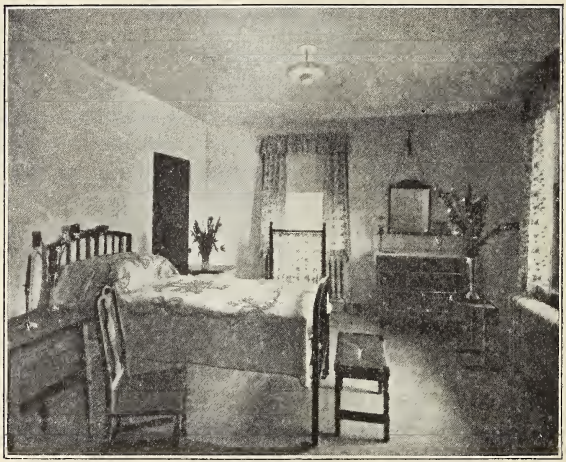
NURSING IN THE HOME

76. Knowledge of home nursing a necessity. Although many people expect to go to the hospital when they are seriously ill, yet some of them, by force of circumstances, must be cared for in their homes. Besides the more serious illnesses there are the minor ones that no family escapes. It would be exceptional to find a family in which somebody did not have a minor illness during the year. Invariably such illnesses are cared for in the home. It is estimated that about 90 per cent of the sick people in the United States are cared for in their own homes. Upon the character of the home nursing depends the recovery of the patient and the safety of other members of the household, especially in a case of communicable disease. Every person should therefore have a certain amount of training in home nursing.

77. Early recognition of illness. It is important to recognize the symptoms of an illness early, both for the welfare of the patient and for the protection of the family. Any marked variation from the normal, such as feverishness, loss of weight or of appetite, inability to sleep, coughing, vomiting, looseness of the bowels, and sore throat should be noted. In any case of illness, no matter how slight, it is always wise to recommend resting, getting more sleep, and eating lightly. Some people have the idea that it is the best plan, when one is ill, to stay on his feet as usual and "wear out the disease." This is a false notion, be-

cause such an expenditure of energy leads to exhaustion and so encourages the illness. If the patient has fever and is distinctly uncomfortable, it is wise to summon a physician.

78. The sick room. Except in very hot weather or in a case of measles a room with a southern exposure is



AN ATTRACTIVE SICK ROOM

Pleasant surroundings aid the patient to recover

desirable. It is likely to be more cheerful, since it will get a certain amount of sunshine each day. It may also be more sanitary, because direct sunlight is a disinfectant.

The sick room should be well ventilated night and day. It should be possible to open windows at the top and bottom. To protect the patient from drafts a screen may be put in front of the window or a sheet may be stretched along the side of the bed and fastened to the posts at

head and foot. In some cases the best results may be secured by putting a window board several inches high under the lower sash. Once or twice each day the room should be thoroughly aired by leaving doors and windows open until the air has been completely changed. The patient should be well covered during this time.

The temperature in the sick room should be between 65° and 68° F. If the patient feels cold, he should be made comfortable by blankets and hot-water bottles.

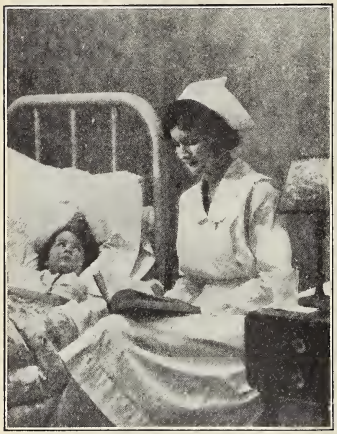
Ordinarily it is not desirable to darken the room, as it imparts a feeling of gloom, but care should be taken that the light does not shine in the patient's eyes.

The strain of caring for a sick person may be relieved by having few furnishings in the room. This facilitates the cleaning. Carpets and heavy window hangings are undesirable, since they catch the dust. Dry dusting or sweeping is never permissible in a sick room. Dustless mops and dusters or dampened cloths are desirable instead of brooms. Except for the noise, which is usually no serious objection, the vacuum cleaner serves a good purpose.

79. Keeping the patient cheerful. One of the faults alleged against doctors and nurses is that they "treat cases rather than people." Besides the physical illness from which he suffers, the patient has a mind. In the midst of trying situations he may be calm, hopeful, and cheerful or gloomy and depressed. Unless the patient can be kept cheerful it will be difficult for him to recover even under the best medical and nursing attendance.

There are many things which contribute to this cheerfulness. The room should be neat and orderly. Attractive pictures brighten a room. If possible, there should be a simple paper on the wall. One of the authors of this

book recalls vividly a nervous condition fostered in a severe illness by a vine in the wallpaper design which invited him again and again to count the number of flowers on the vine. If the patient is able, light reading and a few guests help to make the illness more endurable. The attitude of the nurse is exceedingly important. She needs especially to be cheerful and hopeful.



AN EXCELLENT NURSE

It pays to keep the patient cheerful

80. The nurse's health. Sometimes the nurse becomes so devoted to her task, along with other duties of the household which she may carry, that she forgets her own health. This is a calamity, since the patient is necessarily affected. Her own sleep, diet, and outdoor recreation are essential. A tired, sleepy nurse is in no condition to minister cheerfully to the patient or to carry out the doctor's orders.

81. The patient's bed. A comfortable bed kept in proper condition is essential to the welfare of an invalid. Usually the patient's own bed is best, since anything more or less unusual is likely to annoy one who is sick and to make him imagine that he is more ill than he really is. An iron bed is preferable, since it is easily kept clean and disinfected.

The nurse should endeavor to make up the sick bed so that it looks neat; the sheets should be drawn tight

so as not to cause friction, and the covers should be held firmly in place so as to secure the greatest comfort for the patient.

82. Taking the temperature. In health there is little variation in a person's temperature. The normal temperature is about 98.6° F. As the body gets warmer on a hot day, the blood rushes to the surface, where much of the heat is lost by contact with the air. Perspiration breaks out over the skin, and the body is cooled by evaporation. As the body gets chilled we shiver. This helps to raise the temperature of the body through the contraction of the muscles. By such methods the body undertakes to maintain its constant temperature. When it is unable to do so, it is a sure sign that something is wrong. The temperature is very important; a high temperature is a sign of illness, and any change in temperature indicates with remarkable accuracy whether the patient is improving.

In taking the temperature, first wash the thermometer in cold water, then shake it until it registers not more than 96° F. Next put the thermometer in the patient's mouth with the bulb under the tongue. The patient should keep his lips closed. At the end of two minutes remove the thermometer and record the temperature. It is important to remember that a thermometer should never be placed in the mouth of an infant, frightened child, or unconscious patient.

83. Care of communicable diseases. To prevent the spread of a communicable disease to the nurse, to other members of the family, and to the neighborhood, accurate attention to details is necessary. Disease is caused by germs. Most of these germs leave the body through the discharges of the nose, throat, bladder, or bowels. Water, milk, food, insects, unclean hands, towels, drinking cups,

handkerchiefs, and spray from the nose and throat may be the means of transferring disease from one person to another.

The first essential is isolation. The patient should be put in a room alone and kept apart from other members of the household so far as possible. Children especially should not be admitted to the sick room. Discharges from the patient's body should be disinfected promptly. Discharges from the mouth and nose should be received on gauze or paper, put in paper sacks, and burned. Soiled linen should be soaked in a tub (preferably in the room) containing a disinfectant such as cresol (2 per cent solution) or carbolic acid (5 per cent). It might be more convenient in some cases to put laundry into a clean laundry bag and have the bag and contents boiled. Dishes and silver should be sterilized in hot water. To prevent their being used by other members of the family it is desirable not to have them leave the room. The bowel and urinary discharges should be received in glass or porcelain receptacles and a strong disinfectant added. The discharges should remain in the solution for an hour before being removed.

Not long ago it was common, after the recovery of a patient, to disinfect the sick room with formaldehyde gas or by burning sulfur. This practice was based on the theory that germs are in the air, and that they cling tenaciously to things outside the body. Scientific experiment has shown that germs are really frail creatures that can live outside the body for only a short time. Disinfection by poisonous gas was shown to be expensive and useless. In place of such disinfection it is now recommended that the sick room be cleaned with soap and water, or with bichloride of mercury, and be exposed to the sunshine.

Questions for Class Discussion

1. Why should everybody have some knowledge of home nursing?

2. What are some of the common symptoms of illness?

3. What room should you choose for a sick room?

4. What adaptations should you make for the room that is to be used for a sick person?

5. How may the nurse care for her own health?

6. What are the most important suggestions that you would give the nurse in caring for her patient?

7. How may the spread of a communicable disease to some other member of the family be prevented?

Interesting Things to Do

1. Volunteer to be a home nurse when some member of your family is ill.

2. Get your school physician or school nurse to talk to your class on home nursing.

3. After consulting your librarian, report to the class the names of some good books on home nursing.

4. Let different members of the class report further on home nursing after consulting the American Red Cross textbook on "Home Hygiene and Care of the Sick."

CHAPTER VII

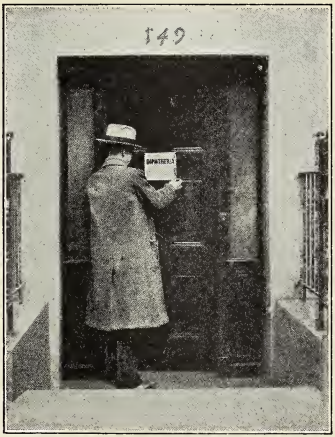
HOW DEPARTMENTS OF HEALTH PROTECT THE COMMUNITY

84. A cry for help. About seventy-five years ago the city of New York made a most astonishing discovery. The inhabitants were dying at the rate of 37 per thousand and the birth rate was 29 per thousand. It was a story of a dying community. The people of that city awoke to the fact that, after all, health was more important than building factories, planning railroads, and making money.

This unfortunate situation had come about from the rapid growth of the city. Similar conditions were found in other cities. People intent on making their fortunes in the city came in huge numbers. Some of them slept in rooms without windows, many of them lived in cellars, the milk and water supplies were neglected, garbage and sewage were uncared for, there was no control over communicable diseases, and the streets were indescribably filthy. The people in New York had not learned how to live together and be healthy.

At this crisis a council of hygiene reported that "sanitary science and its preventive skill are of more value to our fellow beings and to this city than all the curative arts of medicine and surgery." This ringing message by sixteen of the greatest physicians of the city led to the founding of the first city board of health in America. Partly as a result of this new health movement New York has become one of the healthiest cities in the world.

85. The organization of health departments. There are different methods of protecting the community by boards or departments of health, depending on the laws found in different communities. In some states the state department of health has control over the sanitary work of the state. In other states little power is vested in the state department of health, and the public-health work is largely in the hands of county, city, and town officials. The boards of health are sometimes elected or appointed. The board usually engages the services of some health expert. The character, power, organization, and effectiveness of boards or departments of health differ widely according to laws and local conditions. In general the work of health departments in rural districts is not very satisfactory. Usually there is no full-time health officer, and the amount of money expended is not large enough to insure an efficient public-health service.



THIS MAN IS POSTING A QUARANTINE SIGN

It helps to prevent the spread of disease. How?

In the following pages the various kinds of work performed by health departments will be presented. As you read, study your own health department, to discover its excellencies and also its shortcomings.

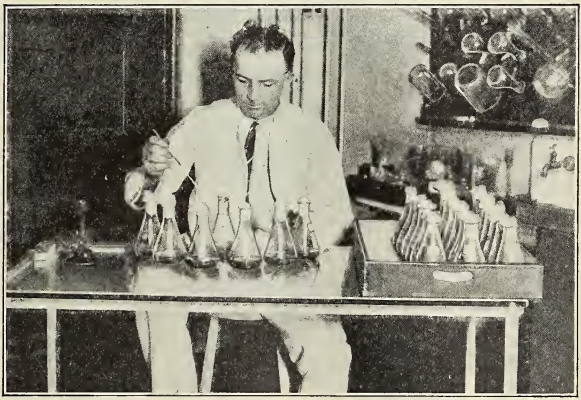
86. Control of communicable disease. This is one of the most important functions of a department of health. Physicians are required by law to report to health departments all cases of communicable disease. This leads to investigation to determine the source of infection. It may be due to a contaminated milk or water supply or to persons who carry the disease. The finding of the cause may prevent an epidemic.

Every person who has a communicable disease is a menace to every other person with whom he comes in contact. Certain diseases, like scarlet fever, diphtheria, and smallpox, require quarantining. This means that the premises are placarded, which proclaims to the public that a certain disease is found there. The patient is carefully secluded except for those who take care of him. Those who live in the same house are often forbidden to go on the street or to enter any public place, such as a school or church. The department of health determines when it is safe for the quarantine to be lifted. Sometimes there are special isolation hospitals provided for those suffering from such diseases.

Many departments of health try to prevent diseases such as diphtheria, smallpox, scarlet fever, and typhoid by offering free immunization to the public. This is especially true during epidemics.

87. Vital statistics. Births, deaths, and marriages should be registered in a health department. Such statistics show what conditions exist and the success of any kind of health work undertaken. For example, the figures show that cancer is increasing. They also indicate that a large percentage of the cases may be cured by early diagnosis and treatment. A decrease in water-borne diseases has invariably followed modern purification of

the water supply. It is a well-known fact that within certain limits a community may purchase health. Cities that spend money in an intelligent way to promote public health get returns in health. Statistics show that public-health work pays large dividends. Every city



A LABORATORY OF A DEPARTMENT OF HEALTH

Scientifically trained workers handle the germs of dangerous diseases in their efforts to protect the community

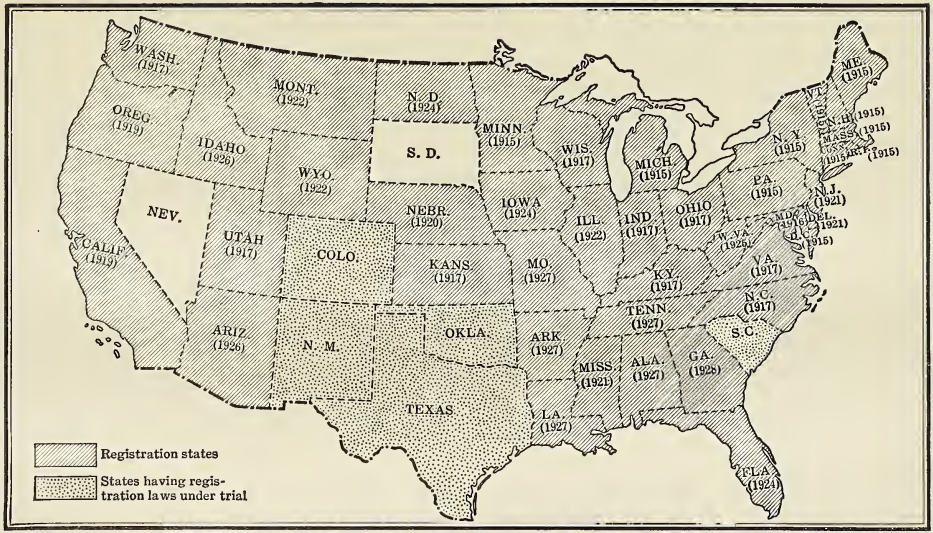
and state needs to collect reliable statistics about health and disease, in order to plan its health work effectively.

88. The health laboratory. The laboratory is absolutely necessary for efficient public-health work. Laboratory workers examine milk, water, and food supplies and diagnose diphtheria, typhoid, tuberculosis, pneumonia, and other diseases. The importance of the laboratory may be easily imagined in the case of an epidemic, when the health authorities wish to find its source. In modern

medical science the microscope is necessary in determining a disease. For example, a child has a very severe sore throat. The physician is unable in the early stages to tell whether it is diphtheria or not. He takes from a well-stoppered bottle a kind of sterile swab on a long wire and gets some of the mucus from the throat. This swab is again returned to the bottle and sent to the health laboratory. The subsequent examination, or more than one, will tell the story. If it is a case of diphtheria, the taking of another culture after the patient has apparently recovered will tell the physician whether it is perfectly safe for him to mingle with other people.

89. Sanitary inspection. Many people think that the chief business of a health department is to get rid of nuisances, and for such purposes a large force of inspectors is often necessary; but many of the practices of sanitary inspection really have very little to do with health. Among them are the inspection of plumbing, the removal of nuisances such as an unsightly litter of papers and rubbish, the oversight of domestic pets, and the clearing up of untidy yards and cellars. It is desirable to control these conditions, but they are more important for the sake of beauty and of fire prevention than because of health.

There are certain kinds of inspection, however, that are important for health: for example, the inspection of privy vaults that may be a menace to a community, the supervision of manure storage and removal and of other fly-breeding situations, and the prevention of mosquito-breeding and rat-breeding. It is desirable that there should be an inspection of lodging houses, factories, and restaurants, to see that they are wholesome.



THE BIRTH-REGISTRATION AREA OF THE UNITED STATES

It is composed of the forty-one states which register at least 90 per cent of all births

90. Nursing service. Since 2 per cent of the population is ill all the time, it is impossible for hospitals to take care of all those who are sick. There must be bedside nursing. In many cities public-health nurses are provided by various associations and by the health departments. They go wherever they are needed, to advise in the homes and to do some bedside nursing.

91. Child hygiene. Many health departments take a keen interest in the health of children. They sometimes provide clinics where infants may be examined by competent physicians. The parents are given advice, and nurses are sent to visit the homes, to see that the doctor's advice is carried out. There are also clinics for older children.

92. Public-health education. The first aim of a department of health is to prevent illness and to promote healthful living. Although a health department may take measures to provide pure water and milk, it cannot force the people to increase their consumption of these liquids. That is an educational problem. Many health departments publish valuable bulletins for physicians and the general public. Some of these bulletins, notably the one published by the Chicago health department, are written in simple language and are well illustrated. The aim is to keep the general public enlightened as to the most recent advances in hygiene and medicine. Many health departments use newspapers generously and provide the public with free health lectures by experts. Correspondence courses on different health problems are sometimes offered. Moving pictures and exhibits are also pressed into service for health.

93. Study of the health of your community. Every citizen should know something about the working of the health department and the health organizations in his com-

munity, so that he may coöperate with them. The following questions will help you to study the health of your community:

1. Have you a full-time health officer? What are his duties?
2. Is there a staff of public-health nurses either connected with your health department or separate from it? What work are they doing?
3. Have you a safe public water supply?
4. Is there a public sewerage system which serves the greater part of the community?
5. Is there a public-health laboratory? Describe its work.
6. Is there an established service for the inspection of the dairy farms supplying milk to the city?
7. Is the milk supply of the community pasteurized?
8. Are there one or more sanitary inspectors in the health department? Describe their work.
9. Are there rules and regulations concerning communicable diseases? Tell about the most important.
10. Are communicable diseases reported? If so, which ones?
11. Is the population well protected against smallpox by vaccination?
12. Are there hospital provisions for the care of cases of communicable disease?
13. Is there a tuberculosis clinic? If so, describe its work.
14. Are births and deaths reported?
15. Is there a clinic for children below the school age? If so, describe its work.
16. Do all kindergarten or first-grade children receive a physical examination at school?
17. Are there any special classes for those who are handicapped in health?
18. Is the care of the health taught in the public schools?
19. Do the daily newspapers and radio carry health messages?

20. Are there private or voluntary organizations working for the health of your community? Name the most important and describe their work.

Try This

After reading the previous chapter carefully, try to fill in the blanks in the following sentences:

1. Before the establishment of health departments the ____ rate sometimes exceeded the ____ rate.

2. Today the ____ of health departments in various parts of the country ____.

3. One of the primary reasons for founding health departments was the need for the control of ____ ____.

4. One way to protect the general public is to ____ every person having the disease.

5. Free ____ is sometimes offered to the public.

6. Within certain limits every community may purchase ____.

7. Every good health department keeps a record of ____, ____, and ____. These records tell whether the health department is making ____ from year to year.

8. The laboratory of a health department aids physicians by telling them whether their patients have particular ____ or not.

9. Most of the nuisances complained of by citizens have little to do with ____. Many of the most ____ nuisances are caused by the breeding of ____, ____, and ____.

10. Departments of health frequently provide ____ where little children may be ____.

11. ____ ____ school may coöperate with the ____ department.

12. Every progressive ____ ____ today is doing something to educate the ____ on ____ matters.

13. Every ____ citizen should ____ to make his ____ ____.

Interesting Things to Do

1. Make a study of your own health department by answering the questions on page 111.

2. Invite somebody in your own department of health to speak to your class about the way that department works for the health of the citizens.

3. Find out how much your town or city spends for health as compared with the amount spent for other things. It amounts to how many cents of every dollar raised by taxation?

4. Find out whether the city ordinances with regard to health are arranged and indexed so they can be referred to.

CHAPTER VIII

SAFE MILK AND WATER SUPPLIES

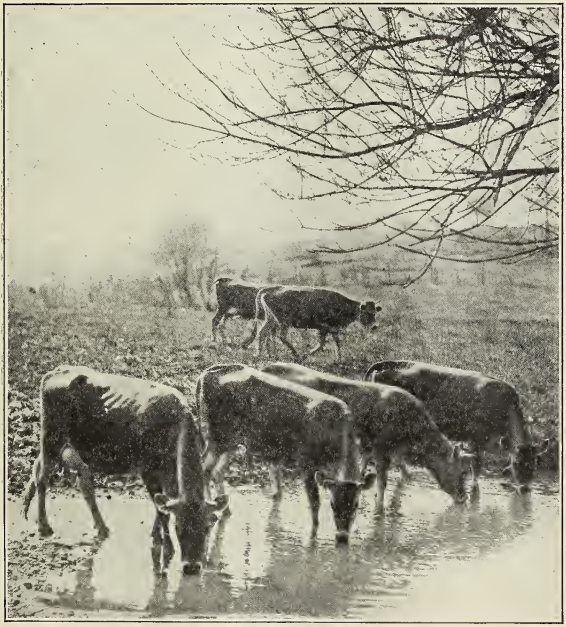
94. The romance of milk. The story of milk is very old. It goes back to the very dawn of history. In some of the oldest books and on some of the ancient monuments we find stories of herds, milk, butter, and cheese. The people who have done most for civilization used dairy products. Dr. E. V. McCollum sums it all up neatly by saying:

The people who have achieved,
who have become large, strong, vigorous people,
who have reduced their infant mortality,
who have the leading commerce of the world,
who have an appreciation of art, literature, and music,
who are progressive in science and in every activity of human intellect,
are the people who have used liberal amounts of milk and its products.

In Bible times milk not only was considered valuable but was the symbol of great things to be desired. When the Jews left the bondage of Egypt and marched toward Palestine, they sent spies ahead to give a report of the country. These men returned to their countrymen and reported it not as a land of jewels and gold but as "a land flowing with milk and honey." There are some fifty references to milk and cows in the Old Testament. Probably the vigor of men like Abraham, Jacob, and David was the result of their living much in the open air and using plenty of milk. Down through the ages

milk, whey, cheese, and butter have played an important part in the lives of the great peoples of history.

95. Modern science as a detective. Communicable disease always leaves tracks behind it. Modern science is



ARTISTS AND SCIENTISTS DELIGHT IN HONORING THE COW
She is one of the builders of modern civilization

often the detective who attempts to track down the criminal. Today, as soon as a case of communicable disease is reported to a health department, the department immediately sets out to find its cause and takes the neces-

sary steps to prevent its spread. In such a study the milk supply is always under suspicion, because milk is a good food not only for people but also for germs.

An interesting story has recently been published in connection with an outbreak of typhoid fever which occurred in a small eastern town. Investigation by the health authorities showed that all those who were ill had patronized the same milk farm. Months previous to this time the department of health had heard that a man was being employed on this farm who was a typhoid carrier. A typhoid carrier is one who has had typhoid and recovered from the sickness, but still carries in his body typhoid germs, which are thrown off through the urine or excrement. While these are not at all harmful to the carrier, when transmitted to other people who have not had typhoid they cause the disease. When the department of health heard that this carrier was employed on the dairy farm, it notified the owner that under no conditions was he to allow the man to do any milking or to do anything in the way of handling the milk. An immediate investigation of the epidemic in the town showed that for some reason this carrier had been allowed to milk. The result was the epidemic. At once the health authorities forbade the sale of this milk until such a time as the carrier might quit his work and the milk be pasteurized and made safe for public use. With such precautions the epidemic speedily decreased and finally disappeared.

96. Safeguarding the public health. This story shows us how dependent we may be on others for good health. The vast majority of people know little or nothing about the history of the milk before it is delivered at their homes. It may be contaminated and filthy or it may be clean

and wholesome. Every citizen should know how the local and state boards of health safeguard the health of the people. Every citizen should also inquire carefully into the quality of the milk that he buys for his family. His choice of milk may determine whether they have sickness or health. This inquiry may be made by reading health reports or by personal investigation. The pages which follow tell the story of how safe milk may be produced.

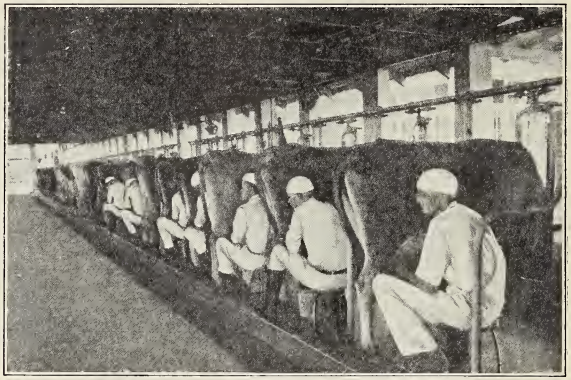
THEY ALL DRINK MILK

97. Healthy cows. The first requirement in the production of safe milk is healthy cows. Often there have been outbreaks of communicable disease that could be traced directly to a diseased herd. Any animal that shows signs of illness should be kept from the remainder of the herd until treated and pronounced healthy. Since bone tuberculosis may be transmitted through milk, all cattle should be tested for tuberculosis. This is made possible through a scientific test called the tuberculin test. In some cases the cows need to be killed. Under all conditions the milk from such animals should be excluded. On the best dairy farms the herd is regularly inspected by a veterinary.

98. General cleanliness. Every care should be taken to keep the cows clean. Pastures, barnyards, and lanes that are free from mudholes make it easier to keep the cows

clean. Most dairies find that one of the best advertisements of their product is general cleanliness.

Cow barns should be clean, dry, well ventilated, and well lighted. Manure should be regularly disposed of and every effort made to prevent fly nuisances. Barn floors made of concrete are easiest to keep clean. Ceilings



A MODEL COW BARN

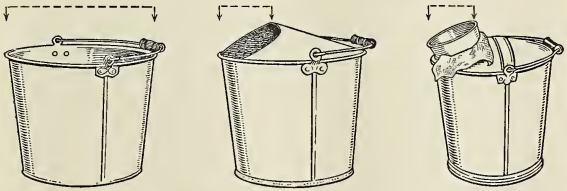
Notice the cleanliness of the barn, the cows, and the milkers

should be tight enough to prevent chaff and dust from sifting through. A whitewashed stable not only looks more sanitary but is more sanitary, since whitewash is a disinfectant. A barn should be whitewashed at least twice a year.

Cleanliness in milking is very essential. Much of the dirt in the milk comes from the cows during milking. Cows should be curried and kept as clean as possible in the stable. Just before milking, the flanks, udder, and belly of the cow should be wiped with a clean wet cloth

and carefully dried. Since most of the dirt in the milk falls from the body of the cow at milking time, the advantage of a hooded milk pail is apparent. Such a pail has a smaller opening and shields the milk from the falling dirt (see illustration below). This kind of pail reduces the number of bacteria.

The kind of can the dairyman uses is less important than his method of cleaning and caring for the cans.



DIFFERENT KINDS OF MILK PAILS

One of these milk pails is best. Which one? Why?

Dirty cans cause milk to sour and give it a bad flavor. Cans should be thoroughly washed and sterilized with boiling water.

In our best dairies the milk is cooled quickly. The bottling is done by machinery, so that human hands do not touch the bottle until it is capped. Previous to the filling and capping, the bottles are sterilized by live steam. The best kind of milk cap is one that fits down over the top and so prevents contamination from handling.

99. The health and health habits of milkers. In most cases contagious disease has its origin with human beings. The milker or handler of milk who is ill or is a carrier of disease is a menace to the milk supply. We have already noticed how a single carrier may start an epidemic in a

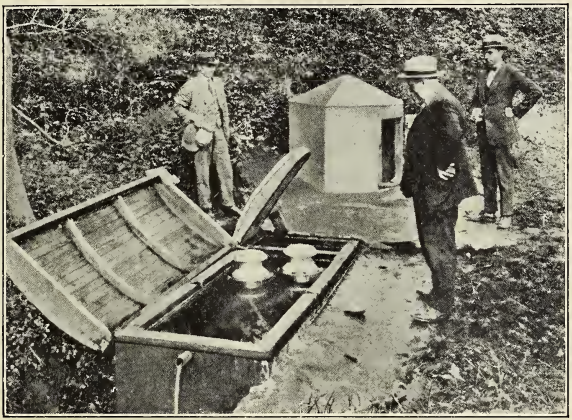
community. For this reason men who milk or handle milk should be examined from time to time to make sure that they are not suffering from disease. In our best dairies the workers are very careful in their personal habits. The milkers wash their hands with soap and hot water, not merely once or twice a day but after each cow is milked. They are also dressed in white clothes, which are changed frequently.

100. Transportation of milk. Even after milk has been carefully produced on a clean, safe dairy farm it may become unsafe because of bad conditions of delivery. It is desirable that the milk should be cooled immediately after milking, and kept cool until delivered to the consumer. Milk is an ideal place for bacteria to grow, but they do not grow fast in the cold. A single bacterium at 50° F. increases to only 5 in twenty-four hours, but when held at 70° F. for the same length of time it increases to 750. Since much of the milk used in cities often comes for several hundred miles and is many hours on the road, the necessity for refrigeration is clear.

101. Pasteurization the greatest safeguard. When milk is produced under the very best conditions, similar to those already described, it is called certified milk. This is raw milk, used especially for babies. It is too expensive for general use. Fortunately science has found a way properly to safeguard milk against the spread of disease without lessening to any great extent its food value or greatly increasing the cost of its production. This method is called pasteurization, after the great Pasteur. The milk is heated to 145° F., kept at that temperature for half an hour, and then rapidly cooled to 50° F. By such a method all disease germs are killed and the milk is made perfectly safe.

The only real objection to pasteurized milk is that it destroys the antiscorbutic vitamin C, but this defect can be safely met by eating plenty of fresh fruit and vegetables. Little children fed on pasteurized milk should be plentifully supplied with orange juice.

Departments of health throughout the country generally recognize the value of pasteurization. In Chicago



A MILK INSPECTOR AT WORK

99 per cent of the milk is pasteurized. Dr. Bundesen, former Commissioner of Health of Chicago, said that since the order was issued, in 1916, "that all milk except certified be pasteurized, there has not been a single case of contagion traced to the milk supply." Such testimony from many health experts shows that pasteurization saves many lives. All up-to-date communities today insist on pasteurized milk. Probably the time will come when the sale of raw milk will be forbidden by law.

102. The romance of water. Man's need of water is one of the great forces of history. Everything that lives — plants, animals, and human beings — must have water or perish. This need has determined where, and to some extent how, man should live. Not only did he need water to drink and use as a part of his food, but he needed it for his flocks, his grain, and his vegetables, and for purposes of navigation. Often he used the waterfalls to turn the wheels of his mill.

It is not pure accident that towns and cities and even great empires have sprung up in particular places. They were all built where water was accessible. In 1621 Captain Miles Standish with a party of Pilgrims was exploring the barren coast of Massachusetts. After several days of exploration they returned with the report that they had "marched into ye land and found divers cornfields and little running brooks, a place fit for habitation." The frontiersman was happy indeed when he found a good building place near a spring. Sometimes he piped the water to his house. For such purposes he did not use metal pipes. A hollowed log, he discovered, made a good open pipe for the water to flow in.

The story of how New York City developed its water supply is fascinating. When the Dutch settled on Manhattan Island, where the heart of New York City is now, they first of all scouted for water. They found a "well-watered island traversed by many brooks abounding in fish; with a large fresh-water pond." By 1664 the population was only 1500 people. Their water was obtained from private wells. Later a public well was dug, but it became contaminated and the supply insufficient. It was necessary to send for water from distant wells. One of these wells was called the "Tea-Water Pump." It was

so popular that its neighborhood became congested with water carts. The people managed to get along with wells until 1799, although at considerable inconvenience. That year the Manhattan Waterworks Company was formed, and the water was brought through wooden pipes directly into people's houses. In the early 1800's, 2000 families were supplied. The company owned over 2500 miles of wooden pipe. By 1840 New York had a population of 400,000 people, and there was not enough water. The engineers went out to Croton, forty miles away, and piped water into the city. New York City was on an island, and the engineers had to use their wits to get the water across to the city. They did not know how to dig a tunnel, so they finally hit on a plan of carrying a huge pipe across a bridge. This was a high bridge, which is still standing. But by 1900 the city had a population of 3,500,000 people. This time they had to go even farther away, to the Catskill Mountains, and build additional reservoirs. These were constructed on a great scale and at great expense. The Ashokan Reservoir covers an area of about 10,000 acres. The greatest difficulty was in getting the water across the river to New York. This was finally accomplished by boring a tunnel 1100 feet under the river.

The story of how a city has developed its water supply is usually one of the most dramatic in its whole history. What is the story of the way your own city supplied the public with water?

103. Science again a detective. Although water is such a positive help to man, it may, when infected, become a menace to health. The principal source of infection is human excrement, for it must be remembered that human beings are the source of most diseases that afflict mankind. So common is the infection of water that in

case of an outbreak of disease known to be transmitted by water it is always under suspicion. It is one of the first things to be investigated by health departments. Among the water-borne diseases are typhoid fever, cholera, and dysentery.

In 1903 one of the most striking epidemics occurred at Ithaca, New York. There were 1350 cases of typhoid in a city having a population of 13,156 people. An investigation by Dr. George Sopher showed that the disease was due to infected water. It was found that on the land drained by one of the streams used by the city for a water supply there were a number of privies. On this watershed there had been several cases of typhoid during the year. The epidemic in the city occurred after a flood in the river.

Because of the great pains taken by cities to make the water supply safe, typhoid has now disappeared in large measure. In fact, city water is likely to be much safer than water drawn from a well in the country.

104. Protection of a city water supply. Some of the smaller cities and many towns that are not near lakes or streams rely on deep wells. Care is taken that the tops of the wells are protected against the invasion of surface water. Such water may be pumped directly into mains or stored partly in reservoirs. There is little danger of infection through this method.

Some cities draw their water from rivers or lakes or artificial reservoirs. Large cities like New York and Boston have made reservoirs at tremendous expense. People are forbidden to live near the sources of supply, and the territory is always carefully policed to prevent contamination. Water so protected and exposed to air and sunlight is likely to be perfectly safe; even if it is

exposed to some slight infection at its source, the bacteria will die before they have traveled the long distance to the water mains of the city.

Some cities and towns must draw their water from sources that are known to be infected. Thus, Chicago draws its water from Lake Michigan, where part of its

A PICTURESQUE VIEW OF PART OF THE WATER-SUPPLY SYSTEM OF CINCINNATI, OHIO

This city is noted for its excellent water

sewage is also emptied. In such cases the supply is drawn from points as far distant as practicable from the place of sewage disposal. Science is then brought to bear to purify the water so that it will be perfectly safe. This is one of the greatest discoveries of modern times.

105. Purification of water for community use. The methods used to prepare water for drinking and all other domestic uses will vary with the sources of the natural water.

1. Natural waters that look clear and sparkling and have an excellent taste often contain the organisms which cause disease, and these must be removed before the water is fit for use.

2. Other waters that are exceedingly muddy and "hard" may contain relatively few microscopic organisms. When such a water is used to supply a community, the only problem is to clarify the water. Sometimes the water is also softened at the community plant, but this is not often done.

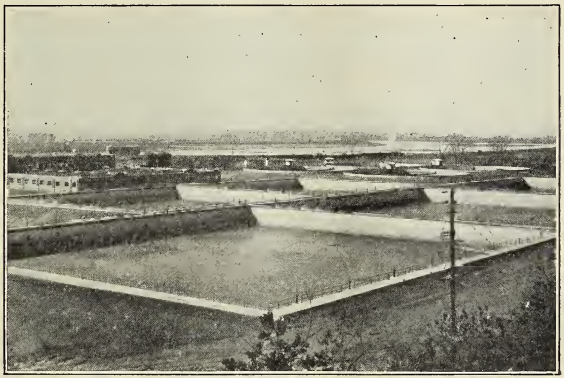
3. Still other natural water supplies may be muddy and may also contain many organisms which endanger the health of the community. In such a case the water has to be clarified and also purified and made safe from a bacteriological standpoint.

In the first case all that is necessary is the addition of a chemical which acts as a germicide, that is, kills the germs in the water. A 1 per cent solution of chlorinated lime is very often used to purify community water supplies. By means of an automatic arrangement the lime is added in just the right amount to sterilize the water.

In the second case the water is pumped from the stream into settling basins, where a part of the suspended impurities settles to the bottom. Sometimes a chemical such as alum is added to the water. The alum, when mixed with the organic matter suspended in the water, forms a gelatinous compound which settles easily. The water is usually allowed to settle in one basin and then run into another, called the coagulation basin, where the alum is added, and from there the water is piped to the filter beds, where it trickles slowly through layers of sand. The filter beds may be about 125 feet wide and 300 feet long. Each bed has a layer of sand about

40 inches deep. Under the sand there is a layer of gravel about 3 feet deep. The bottom of each filter bed is of smooth concrete which slopes toward a drainpipe that serves to collect the water into a pure-water reservoir.

In the third case, if it is necessary also to sterilize the water (remove germs), chlorinated lime may be added



THE FILTRATION PLANT OF KANSAS CITY, MISSOURI

Through such a system it is possible for the city to use with absolute safety the water from the river

to it, or it may be "charged" with a definite quantity of chlorine gas as it is passed from the settling basins to the filter beds.

About fifteen hours is required for the passage of water from the intake to the city main.

The filter beds are cleaned by sending a current of water upward through the sand while the incoming water is shut off. The water washes the sand and is then discharged into a sewer.

Sometimes the water is softened by being passed through a softener containing a compound called permutite. The calcium and magnesium of the compounds which make the water hard replace the sodium in the permutite. Since the silicates formed are insoluble, these two metals are thus removed from the water.

THIS DEPARTMENT OF HEALTH IS LOOKING OUT FOR THE HEALTH OF THE TRAVELER

106. What soap does to water. Soap is an aid in washing greasy dirt from our hands and clothes because it forms an emulsion with the fat. It is easier to wash out the emulsion than the grease. By an emulsion we mean the mixture of the fine particles of one substance with another substance. In this case the particles of soap solution mix with particles of fat and dirt and hold them in suspension so they can be washed out.

107. Individual responsibility for safe water. Most people in cities have nothing to do with the water supply. They pay their water tax, draw their water from a faucet, and assume that it is safe. Since the greatest care is ordinarily taken by cities to protect the water supply, this faith is justified. They hold the city government responsible for the safety of the water. In certain sections of our country, citizens who proved that they had become ill through drinking city water have been awarded damages by the courts. This has tended to make cities even more watchful of the public health.

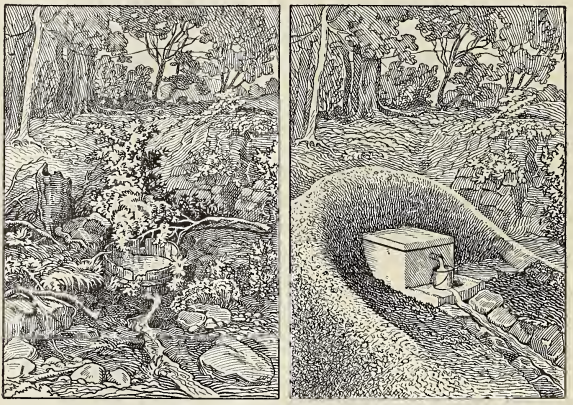
In the outskirts of cities, in small towns, and in rural districts people still use wells and springs. Over these sources of supply government authorities exercise almost no control. Whether the water supply is safe or not usually depends on the intelligence and care of the householder himself. Since many people are either ignorant of modern science or exceedingly careless, infections from drinking-water are common. Added to these dangers is the ease with which wells and springs may be contaminated.

108. Safe wells. A shallow well is likely to be more dangerous than a deep well, because it is easier for it to become infected with contaminated surface water. Wells should never be located within 100 feet from an outhouse, and if possible they should be on higher ground than the house. Contrary to the general notion, infection usually comes through the surface of a well rather than through the soil. The latter may occur, however, when a source of infection is near at hand, such as a privy or broken sewer pipe. In constructing a well great care should be taken to have the casing of the well (usually of wood, stone, or brick) project about 18 inches above the ground. Around this should be built a shield of concrete, or of brick set in cement. The floor or platform over the well should fit so closely to the top of the casing that there is no place for frogs, bugs, or mice to crawl in. The floor should be made of cement or well-joined lumber, so as to prevent leakage. It is through such leakage that a well may be contaminated. It is important that the pump should be protected in such a way as to prevent water from draining into the well.

Deep wells furnish us with the safest and most satisfactory supplies of water. Care should be taken also with deep wells to prevent infection from the top. The land

should slope away from the top. Pipes near the surface should not be allowed to rust and become leaky.

Even water that is perfectly safe when it comes from the well may be made unfit by the unclean habits of those who handle it. Disease may be carried by a drinking-cup.



THE PROTECTION OF A SPRING AGAINST POLLUTION

Enumerate the various ways in which the water in the spring at the left may be contaminated. How is the water protected in the spring at the right?

109. Safe springs. Spring water is subject to all the dangers of water from a shallow well. Special care needs to be taken against pollution. Stables, privies, and hog pens should be distant and preferably on another slope. Animals should be kept away. A wall of concrete or masonry, going well into the ground, should protect the spring against surface washings from above. A ditch dug around a spring will help to prevent the flowing in of surface water. Grass planted around a spring will help to

keep out the dust and prevent the wearing away of the soil. On page 130 note how a spring has been made safe.

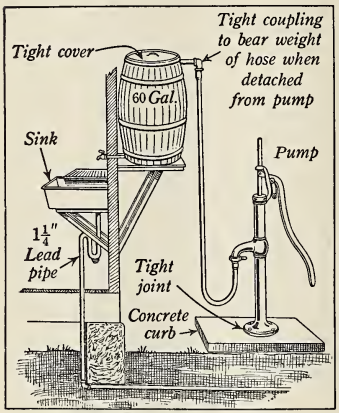
110. Goiter and the water supply. One of the recent discoveries in connection with the water supply is its relation to goiter. This is a disease of the thyroid gland, due largely to a lack of iodine in water and food. The thyroid gland secretes a fluid which contains iodine. If it does not get a proper supply, it enlarges, causing a disfigurement of the neck and other bodily disturbances.

Careful study of this problem shows that there is a relation between the amount of iodine in water and the prevalence of goiter. At Saginaw, Michigan, for example, it was found that the amount of iodine in the water varied greatly in different wells, but that in surface wells it was less than in deep wells. It was also discovered that 75 per cent of those who had goiter used surface-well water. The advantage of using deep-well water was shown by a goiter survey reported by Dr. William De Kleine. In the Webber School 53 per cent of the children had goiter when the survey was made in the spring of 1924. When these children were examined in February, 1925, only 24.5 per cent showed signs of goiter. The children in this part of the city had access to surface-well water of a low iodine content. At school there were plenty of drinking fountains supplying water from deep wells. Since this was a new building which opened about a week before the first survey in 1924, it would seem that the reduction of goiter was due to the use of water having a higher amount of iodine.

It is a noticeable fact that in regions having little iodine in the water, goiter is common. An attempt to correct this has been made by putting iodine into the regular city water supply, or into salt. In some schools

children have been given bits of candy containing iodine. Problems of this kind affecting the diet should always be referred to physicians.

111. Disposal of sewage. In our larger cities the individual citizen has very little responsibility as to sewage, since the city takes care of this by its system of sewers; but in the outskirts of the large cities, and in towns, villages, and rural communities, the individual is responsible. Privies and cesspools should not be tolerated in a closely built area. There are statistics which show that getting rid of privies and installing a sewerage system have reduced the death rate in many cities. Where this is impossible a pit or earth privy or a septic tank may be used. It should always be distant from the well and very carefully screened against flies. In many country homes indoor closets have been installed and a water tank located in the attic. This provides for such convenience and in large measure for such safety as are found in the city. The sewage is conducted by pipes to a large cesspool. If this is properly located, it should not be a menace. Through the installation of modern plumbing the sanitation in rural communities is rapidly improving.



INEXPENSIVE ARRANGEMENT FOR SUPPLYING SINK WITH RUNNING WATER

Useful for summer camp or cottage

AN OLD-FASHIONED COUNTRY WELL

The old oaken bucket has become famous in song and story, but it should be regarded with suspicion. Why?

112. Vacation hints. One of the hazards of travel is the possibility of infection by impure water and milk. Whenever possible we should insist on pasteurized milk in public restaurants. If we are camping in the country, it is wise to make an investigation of the milk supply, to find out the condition of the herd and the cleanliness of the milkmen. If there is any doubt about the purity of the milk, it should be pasteurized at the camp.

In these days of automobile traffic the highway water supply is very important. Ordinarily the automobilist assumes that if water is clear, cold, and pleasing to the taste, it is safe to drink. In spite of all these qualities it may, of course, be very dangerous. In some states the health departments placard wells along the highway, for the information of the tourist. In case the automobilist or tourist is suspicious of the water, it should be boiled. Beating with an egg beater the water which has been boiled will improve its taste. Nearly all state departments of health will examine water free of charge, and should be asked to do so if one is the least bit suspicious of the water supply of a summer camp.

Try This

Write *Yes* or *No* after each of these statements. Every statement is either true or false. Let the class discuss each statement. How many will you get right?

1. The history of milk is quite recent.

2. Most of the peoples who have achieved great things in the world's history have used milk plentifully.

3. Milk is an ideal food for bacteria.

4. Typhoid carriers help spread disease.

5. Pasteurization is no protection against carriers.

6. Any milk sold in bottles is safe milk.

7. Milk should come from healthy cows.

8. The condition of cow stables has little to do with sanitary milk.

9. To prevent spoiling, milk should be kept cold.

10. The presence of water has determined much of our industrial development.

11. When New York City first began to rely on a waterworks company for its water, lead pipes were used.

12. Typhoid may be carried both by water supplies and by milk supplies.

13. All cities draw their supplies of water from rivers or lakes.

14. Water may be made fit to drink by being treated with chlorine.

15. A citizen in the country has little responsibility for the purity of his water supply.

16. Springs are usually safe, no matter where they may be found.

17. Lack of lime in drinking-water is the primary cause of goiter.

18. Good sewerage is a necessity for comfortable and healthy living.

19. Clear water is always safe water.

20. Flies should always be kept away from sewage.

Interesting Things to Do

1. Collect the facts and write the history of the glass of milk which you drink at your table.

2. Collect the facts and write the history of the glass of water which you drink in your own home.

CHAPTER IX

THE BODY AS A HUMAN MACHINE

You know the Model of your Car.
You know just what its powers are.
You treat it with a deal of care,
Nor tax it more than it will bear.

But as to SELF — that's different.
Your MECHANISM may be bent,
Your CARBURETOR gone to grass,
Your ENGINE just a rusty mass.

Your WHEELS may wabble and your COGS
Be handed over to the dogs,
And on you skip, and skid, and slide,
Without a thought of things INSIDE.

What fools indeed we mortals are
To lavish care upon a CAR,
With ne'er a bit of time to see
About our own machinery![1]

113. The body needs expert care. When we stop to think, we know this is true. We do give much more expert care to our cars than to our own mechanism. We know that a punctured inner tube, if neglected, will shortly mean the loss of an expensive tire, and that the loss of the tire will mean, temporarily at least, loss of the use of the car. We know, of course, that a punctured tooth may do the same for the body, and at a still greater cost, but we do not act as though we knew it. One reason is that in the

[1] John Kendrick Bangs, Motors, in "The Cheery Way." Harper & Brothers, New York.

case of the tooth the trouble does not come all at once, as it does when the tack punctures the tire. Often the tooth trouble creeps upon us so gradually that we do not realize the connection between cause and effect.

To take good care of a car we need to know something about its mechanism and the way it works. The use of inferior oil and inattention to little difficulties may lead to accidents or to its rapid deterioration. Careless drivers may so misuse a car that after it has been run no more than 15,000 miles it may be worn out and worthless; another person who understands its parts and how to run and protect it from wear may run the same kind of car 50,000 miles and it will still be capable of giving service.

The human body also is a complicated machine similar to an automobile. If we use it in the right way, it may give us service for seventy-five or a hundred years. If it is abused, it may wear out early in life and rob us of much enjoyment and happiness. For that reason it is desirable for us to know something about our own bodies and how they perform their work.

114. Every machine transforms energy. Any machine is merely a device for changing energy from one form into another. There are five generally recognized forms of energy: mechanical energy, heat, sound, light, and electrical energy. In the automobile we can easily see how the transformation of energy takes place. The starter changes electrical energy into mechanical energy; the horn changes electrical energy into sound; the headlight changes electrical energy into light; and the spark plug changes electrical energy into heat, which ignites the gasoline vapor in the cylinder. As the energy in the gasoline is liberated, the car moves forward mechanically. Every kind of energy can be changed into mechanical

energy, that is, made to perform work. Nobody would expect to substitute light for electrical or mechanical force in driving an ordinary machine, — to hold a lantern near a lawn mower, for example, — and expect work to be done; but the actual light from the sun can be utilized in turning the wheel of a very delicate machine which can be seen in an optician's window. It is called a radiometer. This instrument has a little rimless wheel with a paddle set obliquely on each spoke. The whole rotates on a jewel in a vacuum bulb. The light rays streaming down on these paddles cause greater pressure on those with the flat surfaces uppermost, and cause the wheel to revolve just as if a tiny blast of air were directed upon it.

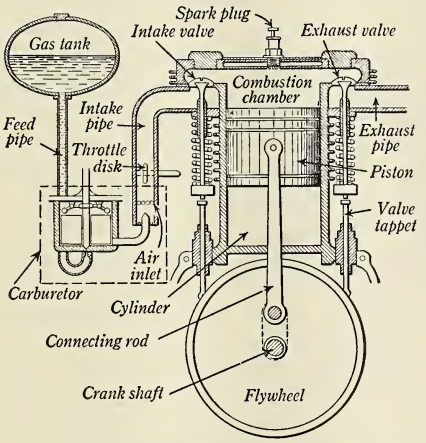
The human machine is comparable in many respects to the internal-combustion engine which draws our automobiles, motor boats, and airplanes. Food constitutes the fuel of the machine. When combined with the air its energy is transformed into heat, muscular and glandular activity, and thought. Some of the energy is stored in the parts of the bodily machine itself, as in the growth and development of the bones, muscles, and fat.

115. Important differences between the human machine and other machines. The human body is not simply a machine; it is a *human* machine. Unlike the automobile it may grow, repair itself, and think. It is self-directive. Imagine, if you can, an automobile that would start itself down the street, avoid pedestrians and the general traffic, and then run home into its garage.

116. The study of a combustion engine. The parts of an internal-combustion engine are familiar to almost all of you. A very clear diagram of the parts of such an engine, without reference to the use to which it is put, is seen on page 139. A diagram of a car, with the parts of the body

to which it is comparable, should be put on the board in your classroom by one of you who likes machinery.

Let us now study with care the diagram of the internal-combustion engine seen below, so that we may understand just how it operates. First find the gas tank in the upper left-hand corner of the diagram. The gasoline



THE PARTS OF AN INTERNAL-COMBUSTION ENGINE

Be prepared to explain to the class the way it works

is the fuel. By force of gravity it flows down through the feed pipe into the carburetor. Here it is joined by air, containing oxygen, which comes in through another opening, marked "Air inlet." Fuel and air are mixed together in the right proportion for burning — just enough oxygen for the gas. The mixture passes on through the intake pipe into the cylinder just above the piston. This part of the cylinder is marked "Combustion

chamber." Here the energy caused by the sudden explosion of the gas when set on fire by the spark in the combustion chamber is changed into mechanical power which depresses the piston. Notice that the piston has a connecting rod attached to it, which ends in the crank of a small flywheel which is turned and is used to move whatever sort of machinery the engine is designed for.

117. General comparison of human body and engine. In the human body our food is the fuel. When made into a uniform solution by digestion this prepared food is carried through the feed pipes (blood vessels). Oxygen from the air is added in the lungs and is carried by the blood to the cells. In the living cell this oxygen combines with the carbon and hydrogen of the foods, and energy is generated. This energy is transformed into various sorts as needed in the work of various organs. Unutilized energy is given off as heat, which keeps the whole machine at the proper degree of warmth for running.

It is well to remember that the human machine is not so well understood as an automobile. Nevertheless, science has made great strides in the last generation in clearing up many superstitions and defining the boundary between what we know and what we do not know.

118. Cells compose the living part of the body. The human body is not as solid as it appears to be. Under the microscope we notice that it is made up of countless millions of tiny units called cells. Each of these cells, if taken from the human body and kept under proper conditions, will continue to live, breathe, throw off wastes, and perform the necessary functions of life. There are many microscopic plants and animals consisting of only one microscopic cell. When a yeast cell is placed in a solution of sugar and water, it uses up the sugar and frees a

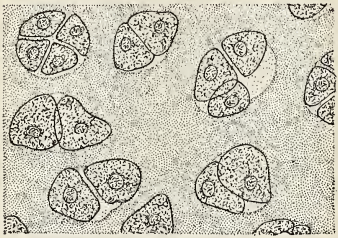
gas called carbon dioxide. A cake of yeast and the body of a human being are similar in being made up of cells, except that each of the yeast cells is independent of every other cell in its work, while the human body is a great community of cells all working together. Then in man there are different kinds of cells doing different work. Just as in a community some people are lawyers and others are teachers and farmers, so in the body some groups of cells are concerned in moving the body, and others in its protection.

YEAST CELLS

These one-celled organisms are similar to the cells of the body

119. A tissue. Groups of similar cells doing the same kind of work are called tissues. The tissues are the building materials of the body in the same way as wood, brick or stone, roofing material, and glass are building materials of a house. There are seven kinds of tissue: muscular, bony, fatty, glandular, epithelial, nervous, and connective tissues. The muscular tissues have the power to contract and shorten, and to relax and lengthen like a piece of rubber when it is stretched. They move the body. Walking, talking, and all physical work are performed by the muscular tissue. Bony tissue is very hard, for its cells deposit lime salts. It is through the bones that the body is able to keep its shape. In the fatty tissue the cells are filled with oil. This is a reserve store of fuel. In illness we notice that fatty tissue tends to disappear.

Glandular tissues are an essential part of organs in which chemical changes take place. In a cow, for example, the mammary glands secrete milk; saliva and sweat are secretions of other glands. Epithelial tissue covers the surface of the body. The skin, hair, and nails are made of epithelial tissue. Nervous tissue is made up of cells with microscopic fibers which connect different parts of the body. They carry messages from the sense organs to the brain and spinal cord, and thence to the muscles. The connective tissue consists of fibers which bind all the cells together. If it were not for the connective tissue the other cells would fall apart from each other, and the body would collapse into its individual cells.



CELLS THAT MANUFACTURE CARTILAGE, A FORM OF CONNECTIVE TISSUE

The outer ear and end of the nose are composed largely of cartilage

120. Organs and systems. An automobile has a number of rather independent machines, such as a magneto, carburetor, and water pump. In a similar way, the body has machines composed of various tissues. The heart, lungs, and liver are organs. The liver is composed of gland cells supported by connective tissue. It secretes bile, which is used to digest the food, and is also a storage depot for sugar.

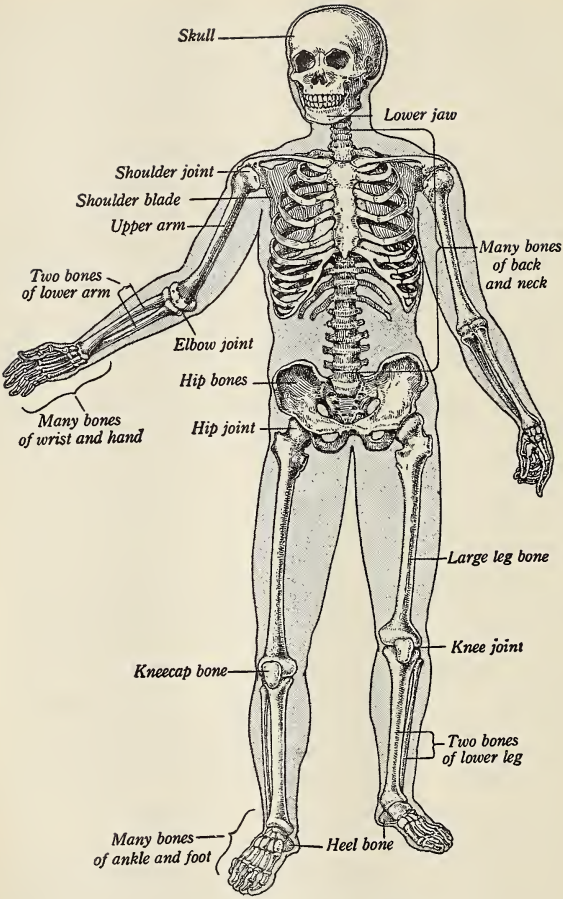
The automobile has sets of machines, each one doing a special kind of work. For example, the battery and wires compose one set, or system, of machines. Perhaps you can tell about the other systems of an automobile. The

body likewise has many systems. The digestive system, for example, is composed of mouth, esophagus, stomach, intestines, and other organs that are concerned with the preparation of the food so that it can become a part of the blood. There are eight different systems which we shall consider in this book: skeletal, muscular, digestive, circulatory, respiratory, nervous, excretory, and endocrine. We shall now discuss each of them briefly. The chapters that follow will discuss some of them more in detail.

121. The skeletal system. There are about two hundred bones in the body. They are the only rigid structures in the body. Joined together in one complete structure they are called the skeleton. They are necessary in much the same way as a framework is necessary for a building. The skyscraper depends for safety and utility on its steel framework reënforced by concrete. Should the framework crumble, the building would fall into pieces. Without a bony framework the body would also collapse into a shapeless, flabby, motionless mass.

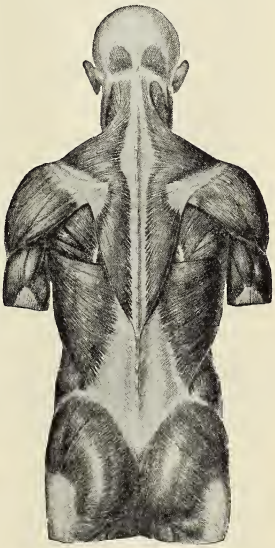
The skeleton may be divided into three parts: the head, trunk, and limbs. The bones of the head are of very great importance, because many of them form the skull, which protects the brain. These bones are fitted together with great ingenuity, so that the brain, the seat of our mental life, is well protected. The bones of the trunk hold and protect vital organs such as the heart, lungs, and organs of digestion. The limbs, the feet, and the hands, under the control of the muscles, enable us to walk, stand, handle tools, and perform most of our work. We shall learn more about the bones in Chapter XV.

122. The muscular system. There are three different kinds of muscular tissue. The striped muscles that are attached to the bones are known as skeletal muscles.



THE HUMAN SKELETON

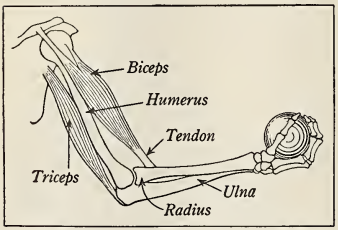
Since they are under the control of the will, they are also known as voluntary muscles. The smooth, involuntary muscles are found in the internal organs, such as the stomach and the intestines. The heart muscle is a still different type between the two. Every movement of the body is the result of the contraction and relaxation of the muscles. We are familiar with the muscles because of the meat that we eat. Our own muscles are like the red meat of beef. An examination of boiled beef, shredded, shows that it is made up of fine fibers. Any muscle, such as the biceps (the arm muscle which boys ask us to feel of), is really composed of many fibers. When the muscles are used continuously, they manufacture a waste product which results in fatigue.



THE MUSCULAR SYSTEM

123. The digestive system. Digestion includes all the processes concerned with the preparation of foods that we have taken into our bodies for use in the cells. The food that enters the alimentary canal by way of the mouth travels along a passageway which ends with the large intestine. Different parts of this tube are known as mouth, esophagus, stomach, and small and large intestines. Into this canal are poured the secretions of many glands, such as the liver and pancreas.

The food becomes dissolved and undergoes chemical changes so that it may pass through the walls of the alimentary canal into the blood stream and be used by the cells for growth, repair, warmth, and action. Chapters XII and XIII will tell in detail about the organs of the digestive system and the changes that take place in the food.



THE MUSCLES OF THE BODY WORK IN PAIRS

When the biceps muscle contracts and shortens, the triceps relaxes and lengthens. Then, as the triceps shortens, the biceps lengthens

124. The circulatory system. This system is made up of an endless system of pipes (arteries, veins, and capillaries) carrying a liquid called blood. This liquid is pumped around the body by a force pump, the heart. The blood stream carries food from the digestive system and oxygen from the lungs to the cells and also carries off the waste product of the cells. Look at the drawing on page 157; also read Chapter X for further discussion of this topic.

125. The respiratory system. In this system we have a number of organs working together to supply the blood with oxygen and also to rid the blood of carbon dioxide and other waste products from the cells. The air is drawn into the lungs through the nose and windpipe (see drawing on page 175). In the lungs the air circulates in tiny air chambers, where some of its oxygen is taken up by the blood. As the air is forced out of the lungs it carries with it wastes which it has accumulated from the blood circulating in the lungs. Does an automobile breathe?

Where does this take place? If you do not know, ask somebody who does know to explain it to you. Chapter XI tells you more about respiration.

126. The nervous system. To work properly the body needs to respond as a whole. It would be impossible to learn to play the piano if each finger responded independently of every other finger. Life would not be worth much if in crossing the street the honk of the automobile horn did not lead us to operate both our legs to get out of the way. The nervous system is really a very complicated combination of nerve cells and fibers, which connects the sense organs, such as the eye and the ear, with the muscles and glands. The whole plan is similar to a telephone system. Every telephone has its central office, where there are switches and where connections are made. In a like manner, the brain and spinal cord in the nervous system act as switching stations for nerve currents. Without the nervous system we should be unable to control our behavior or to have the characteristics which we call human. See Chapter XVIII for further discussion of the nervous system.

127. The excretory system. Every kind of machine has waste products that cannot be utilized. In the case of the ordinary coal-burning engine there are ashes, soot, and smoke. If they are allowed to collect, as ashes might in the ash box, the fire may go out and the engine may stop. In the automobile the exhaust pipe gets rid of much of the waste product. The throwing off of bodily wastes is known in physiology and hygiene as excretion. We have already noticed that some excretion takes place through the lungs. Some of the wastes are excreted from the blood by the kidneys in the form of urine. The larger amount of bodily waste, in the form of undigested food,

is thrown off through the large intestine. It is easy to understand that the excretory function of the human body is important. If anything interferes with this, the bodily machinery becomes clogged and sickness results.

The endocrines, or glands of internal secretion, do not make a unified system, but they are essential for life and

A ROBOT, OR MECHANICAL "MAN," WITH ITS INVENTOR

Although a wonderful creation, it is less remarkable than a human being

health. A study of this interesting part of physiology and hygiene is taken up in Chapter XIV.

128. The human body more wonderful than inventions. In this marvelous age of science remarkable inventions like radio, television, motion pictures, and talking pictures have astounded the world. Recently mechanical "men" have been manufactured which can be made to walk or to give certain answers or even to do certain tasks. It has been hinted that we are on the eve of still greater discov-

eries and inventions that will revolutionize the world. A new telescope is now being built which will carry us out into space a billion light years. You may know that light travels 186,000 miles per second, and that the distances in space are so vast that they are measured only in terms of the time it takes light to travel.

It is now known that there is a tremendous amount of energy (called atomic energy) which, if made available, would make us independent of wood, coal, and oil as fuel. There is probably enough energy in a glass of water to drive the giant *Leviathan* across the ocean. Although we know the energy is there, we have not yet learned how to get at it.

It is an age of thrill which tempts us to build air castles and dream great dreams of the future. Prediction is unsafe, but it seems indisputable that no mechanical device will ever equal the wonders of the human machine. The body is the seat of many physical and chemical changes, and is so intricate that we have doubtless made only a beginning in understanding it. Because of his large brain, capable hands, and language power, man will probably always be greater than anything he may invent.

Review and Thought Questions

1. Who was John Kendrick Bangs? Did he write anything else on health?

2. Do most of the people you know give as expert care to their bodies as they do to their automobiles? What expert care does the body need?

3. What is the chief reason why we need to know something about the way the human body is made?

4. How is the human body like an engine?

5. How does the human body differ from an engine?

6. What is the smallest unit of the human body? Tell all you can about it.

7. What is a tissue? Compare it to the building materials of a house. Name the tissues.

8. What is the difference between an organ and a system?

9. Describe briefly each of the systems of the body.

10. What can an automaton, or mechanical "man," do? In what respects is it inferior to man himself?

11. Which of the systems controls the muscles?

12. Which system gives the body its shape?

13. Which system carries nutrition directly to the cells?

14. Which system supplies the lungs with air?

15. Which system moves the bones?

Interesting Things to Do

1. Collect some other poems, similar to that by John Kendrick Bangs, for the bulletin board.

2. Try to find in other books illustrations of the different systems.

3. Ask your father if you may tell him how the human body is like an automobile. Report to the class. Did you make any mistakes? What were they? Did you learn anything you did not know before?

CHAPTER X

HOW THE CELLS LIVE

129. The body is composed of cells. Since the body is one vast combination of cells, it is easy to understand how important it is to keep them in a state of health. You may be surprised to know that each of the billions of cells in the human body breathes, throws off waste products, and leads a life of its own. Perhaps the best way to understand how these cells live is to study a form of life that has only one cell.

130. Capturing an ameba. If you have a microscope in your school, it would be fun if the teacher could get a few drops of water with a medicine dropper from a pool of stagnant water and have you examine it. She may have to try several times, but finally you may see one or more living things that look like lumps of colorless jelly. Each is a one-celled form of life called an ameba. The substance of the cell is called protoplasm. This is the living substance of every cell. As you notice it you will see that the ameba changes its form and seems to roll along as if propelled from within. Although it has no special organs, it is able to adapt itself to its surroundings and live. It has no mouth or stomach but flows around its food, absorbs what it needs, and finally throws off the part that is indigestible. When it grows too large, it divides and makes two amebas.

131. Combustion and osmosis. Every cell, when active, undergoes a process of combustion. We are familiar with

combustion in an ordinary fire. The oxygen of the air unites with the carbon of the wood. In a general way the wood is changed into certain gases, ashes, and smoke, and heat is given off during this process. It is a little more difficult to understand the process of combustion in the cells, but we know that it takes place. We know that when we exercise, the body becomes warmer.

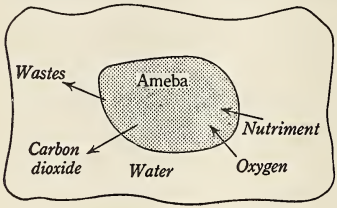


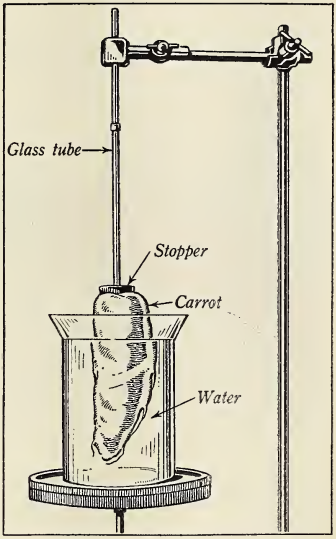
DIAGRAM OF AN AMEBA

Notice how this cell exchanges carbon dioxide and wastes for oxygen and nutriment. Living cells in the body act in the same way

Let us see how respiration takes place in the ameba (study the illustration). As the process of combustion goes on, the amount of oxygen in the ameba decreases and the amount of carbon dioxide increases; the surrounding water has a considerable amount of air dissolved in it, and soon the ameba has less oxygen and more carbon dioxide than is found in the surrounding water. Now an interesting thing takes place. The oxygen in the water passes into the ameba through its very thin cell wall, and the carbon dioxide in the ameba passes into the water. In other words, the ameba exchanges its carbon dioxide for oxygen, by a process of osmosis. The principle of osmosis might be stated in this way: When two liquids or two gases are separated by a thin membrane, there is an exchange through the membrane, so that they tend to be equal in concentration. Also it is largely through osmosis that the cell gets rid of its wastes and takes up its nutriment.

Let us keep in mind this fact, that wherever we find living cells, whether in the plant world or in the animal world, these two processes are taking place, — combustion and osmosis. Study the experiment given below:

Experiment. An interesting way to show osmosis is to hollow out a carrot, leaving a very thin shell, and carefully scrape off the tough skin. Fill this hollow carrot with sugar and water and plug it up with a piece of carrot cut to fit the top. Run a short piece of straw or a glass tube through the plug down into the thin sirup which fills the carrot. Immerse the carrot in a jar of water. The water pushes in through the cell walls of the carrot faster than the sirup presses out. The diluted sirup, therefore, will finally run out of the top of the straw or will rise in the glass tube so that you can see it.

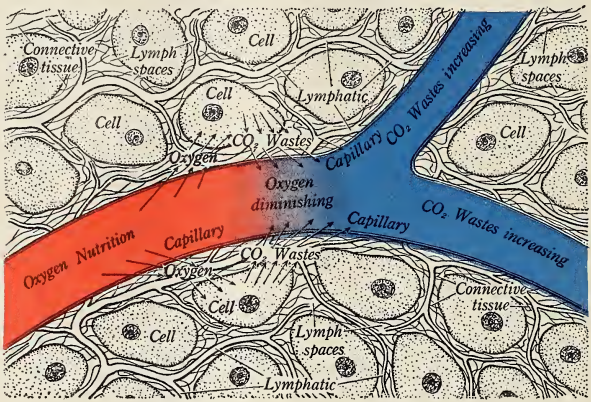


APPARATUS TO DEMONSTRATE THE PROCESS OF OSMOSIS

132. The cells are bathed in lymph. You may be surprised to know that the cells of the human body do not come directly in contact with the blood. They are surrounded by a colorless fluid called lymph. This is the kind of fluid that we see in a blister. In between the cells there are tiny passages, called lymphatics, that drain off

the lymph from the tissues. They empty into larger and larger tubes, and finally into a large blood vessel in the neck. Exercise stimulates the flow of the lymph.

133. How oxygen and nutriment get from the blood to the cells of the body. The blood is confined in a system of endless



THE WORK OF THE BLOOD AND LYMPH AMONG THE CELLS

What do the cells receive from the lymph? Do you know what the lymph receives from the cells? What does the blood in the capillaries receive from the lymph?

tubes called the arteries, veins, and capillaries. A pump called the heart forces blood through this system of pipes to all parts of the body. This great stream of blood collects oxygen as it flows through the lungs and collects nutrients as it flows along the food track, or the alimentary canal.

Glance at the illustration, and you will see that through the process of osmosis the cells in the lymph, like the amebas in the water, are taking up oxygen and nutrients from the lymph and returning to the lymph carbon dioxide and

other wastes. Again notice how the lymph gives up to the blood its carbon dioxide and wastes, and takes over oxygen and nutriment.

134. What happens in the lungs. The process of osmosis helps us to understand also what takes place in the lungs. By studying the illustration (page 175) you will notice that air enters the lungs through the nose and windpipe, or trachea. The trachea divides into two tubes called bronchi, which, as you will see in the figure, branch left and right and enter the lungs. Here they divide and subdivide until the last very tiny branches end in a group of bubble-like expansions, like grapes on their small stems. These are called alveoli. The whole mass of these fine, thin-walled cells, with their tubes, makes up the lungs. The walls of these air passages, if spread out in one layer, would cover the floor of a room 30 by 30 feet in area.

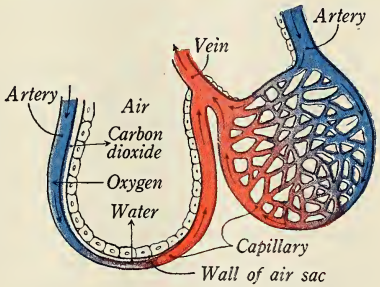


DIAGRAM OF AIR SACS IN THE LUNGS

What exchange takes place between the air in the air sacs and the blood? Explain

A saclike membrane, the pleura, surrounds and holds this mass in shape. This pleura is double; the outer layer is tightly adherent to the wall of the thorax, the inner to the lungs. In between is a smooth watery fluid, or serum, which prevents friction of the lungs upon the body wall, so that we do not ordinarily have any sensation when we breathe.

A rich network of very fine, thin-walled blood vessels, the capillaries, are spread throughout the thin walls of the alveoli. The walls of these are so very thin that the gases from the air and from the blood pass freely back and forth through these walls. Through the process of osmosis the blood gives up its carbon dioxide, which passes into the air sacs and is thrown off with the expired air. The oxygen in the air sacs passes through the walls of the capillaries into the blood.

By this time we should understand that the real respiration takes place not in the lungs but in the cells. If you have read carefully and have thought as you read, you ought to be able now to describe the journey which the oxygen in the outside air takes as it goes to the cells. Then you can trace the journey which the carbon dioxide and other wastes take as they are thrown off into the lymph and are finally discarded.

Let us now learn more about the circulation of the blood and the blood itself.

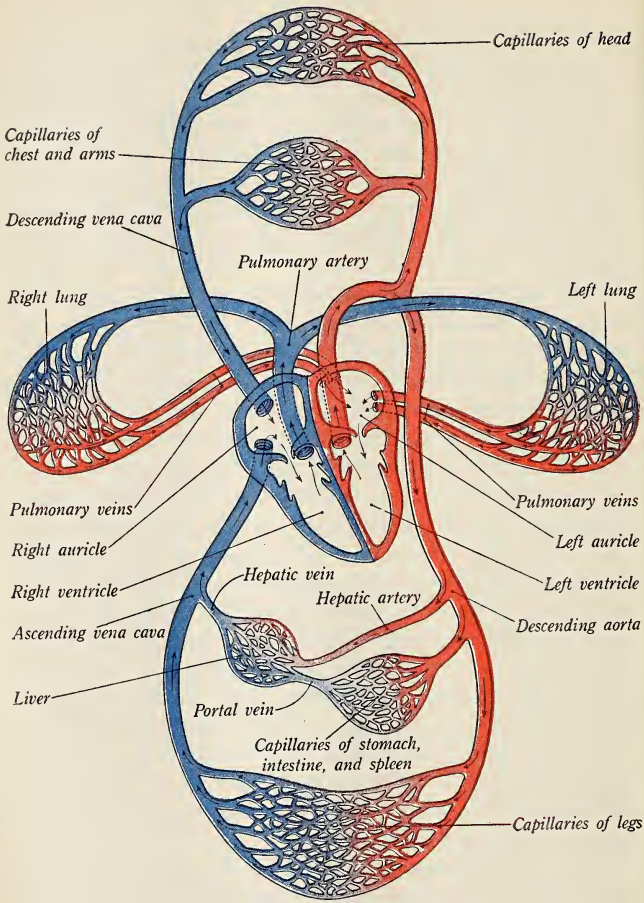
135. The heart as a pump. The central pump is the heart. It is really two pumps set side by side for convenience, but they do not communicate with each other. You will notice this in the illustration on page 158 and also by examining a pig's or beef's heart which you may get at a slaughterhouse. The left side of the heart pumps the blood to all parts of the body except the lungs, the right side to the lungs only. The right side, therefore, has much thinner muscular walls, since it has comparatively easy work to do.

You will notice that there are four chambers in the heart. The two upper ones are called auricles, and the two lower ones ventricles. The heart is composed of muscle, and as the walls contract, the chambers become

smaller, forcing the blood out. As the auricles contract, valves open in the walls between the auricle and ventricle, and the blood is forced into the ventricle. Then the same valves close, so that, as the ventricles contract, the blood cannot flow backward. The tubes leading from the heart are called arteries, and those conducting blood toward the heart are veins. The capillaries are the fine tubes which penetrate the tissues and connect arteries and veins.

After the blood is purified in the lungs it is conducted to the left auricle by the pulmonary veins, is then driven into the left ventricle, and finally passes out through the aorta, a large artery, to all parts of the body. After circulating among the capillaries and giving up its oxygen and receiving carbon dioxide and other impurities in return, it goes back to the right auricle of the heart by way of the vena cava vein. Next it is driven into the right ventricle, and thence through the pulmonary artery to the lungs. After the blood gives up its carbon dioxide and other impurities and takes on a supply of oxygen, it continues on its way to the left auricle through the pulmonary veins. As you study the circulation on page 158 you will notice that the arteries, with one exception, carry the bright red arterial blood which has been purified. The pulmonary artery carries the blue, impure blood. The veins also carry the dark blood, with the exception of the pulmonary veins. Valves distributed in various places throughout the blood vessels prevent the blood from going the wrong way.

136. The blood stream. The blood, which plays such an important part in bringing nutriment to the cells and carrying off waste products for elimination, is made up of cells called red and white corpuscles, and a liquid, called



THE CIRCULATION OF THE BLOOD

plasma, in which these cells float. When the plasma passes through the walls of a blood vessel into the spaces between the cells, it is known as lymph. About 40 per cent of the blood is plasma. The total amount of blood in the adult human body is about a gallon and a half and makes about one thirteenth of the body weight.

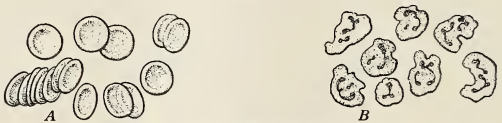
137. How clotting protects the body. Dissolved in the fluids of the blood is a substance called fibrinogen, which is especially important, since it causes the blood to clot. When freshly drawn blood comes in contact with the air, fibrinogen is changed into shreds called fibrin. This holds the solid elements of the blood together and forms the usual blood clot. In case of accident such a clot may prevent serious loss of blood. The blood does not clot in the veins and arteries, because the living cells secrete a protective substance which prevents the formation of fibrin.

Sometimes we find people who are called bleeders. This means that when their blood flows it does not form a clot but keeps on flowing. This is believed to be due to a lack of calcium salts, for it has been found that when calcium in some form of salts is placed on a wound, the blood will coagulate. Calcium is given to bleeders before they have an operation.

138. The red corpuscles. The red corpuscles are round, disk-shaped bodies, so tiny that it would take ten million of them to cover a square inch. The red corpuscles contain an important substance called hemoglobin, which contains a good deal of iron. The hemoglobin has a great affinity, or attraction, for oxygen. When it is heavily laden with oxygen, it is bright red, giving that color to the pure blood. When it has given up its oxygen as it flows through the capillaries, it changes hue, giving to venous blood a bluish color.

The worn-out red corpuscles are broken down in an organ called the spleen. It is supposed that the red bone marrow uses this broken-down material in the blood to make new cells. The average life of red corpuscles is about eighty-three days. They are formed in the red marrow of the bones at the rate of four hundred and fifty billion a day.

139. The white corpuscles. These corpuscles are colorless and shapeless. They have an independent life of their own similar to that of an ameba. They ooze out between



BLOOD CORPUSCLES

Red corpuscles (*A*), white corpuscles (*B*). What is their work?

the cells of the body, collecting in great numbers where there is an invasion of bacteria. They literally eat up the bacteria by oozing around them and soaking them up as food. These white blood cells are the scavengers and the soldiers of the body. Their battle against disease is a romantic story.

Any germ disease is in part a war between the white blood cells of the body and the bacteria that are trying to enter the body and multiply in it. Sometimes the bacteria are too many for the white cells, and then the fight goes the wrong way. The white cells may be destroyed by the poison of the bacteria. Illness results. Eventually the white cells gain the upper hand or the bacteria die off, running through their set course. A fever means that such a fight is going on in the body. The amount of energy expended in the fight raises the temperature of the body.

The blood also contains antibodies, such as the antitoxins that we studied in Chapter III, which make some persons immune to certain diseases.

140. Blood types. It is often necessary, in case of the destruction of a large mass of skin by burns or other accidents, to graft skin from an uninjured person. Blood is often transfused from the veins of a well person to one suffering from anemia or hemorrhage. Not all persons' blood will "match," however. In order to know whether the grafted skin will grow, or whether the donated blood can be utilized by the patient, it must be determined whether the bloods are of the same type. There are four known types of blood, each of which will combine with none of the others. Although nobody knows why a certain person's blood can be adopted into one person's body and not into another's, the fact is easily demonstrated by simple tests. These tests are performed in hospitals before an operation of skin-grafting or transfusion.

141. How to have good blood. Following the rules of healthful living is good for the blood. The blood should have good red and white corpuscles and plenty of them, a sufficient amount of clotting substances, plenty of food substances, such as protein, minerals, salts, and fat, and be richly supplied with antibodies, or protections against disease.

To have good blood one should eat a balanced diet. This should include the regular, daily use of milk, green vegetables, fruits, and whole cereals.

The blood, to be good, must not be poisoned with bacterial toxins, or poisons, from diseased teeth or tonsils, which will eventually destroy the white corpuscles and thus make one an easy prey to certain diseases, or injure the red corpuscles and thus produce anemia.

The blood should have plenty of antibodies. These may be produced artificially by vaccination against smallpox and by inoculations against typhoid and diphtheria. It is now believed that every young person should have these immunizations. In case of susceptibility to colds, hay fever, or asthma, in epidemics of scarlet fever, and when a person has been bitten by a dog or has stepped on a dirty nail or splinter, other kinds of serum inoculations should be used to increase the protective power of the blood.

142. The care of the heart. The heart seems to be working all the time, but actually there is an interval of rest between each two beats, so that it is really working only about half the time. When the heart beats faster, as it must when more oxygen is consumed in some part of the body through muscle exercise, as in running, or mental exercise, as in fright or excitement, it gets less rest and less chance to exchange its own carbon dioxide and waste for fresh oxygen and nutriment. The lungs cannot keep up with the demand, and so we get "short of breath" and must stop to rest. The heart also becomes fatigued. During sleep the heart beats more slowly and thus gets additional rest. The heart beats faster when sitting than when lying, and still faster in standing, walking, and running.

When one keeps up extra heart action too long, as young people sometimes do in competitive sports like bicycle riding, the heart may do several things: it may enlarge, or dilate, or the valves between the auricles and ventricles may become stretched so that they cannot completely close the openings between beats. In this case some of the blood "swishes" back into the auricle when the ventricle closes. This is called a leak. Some leaks may not be discovered or make any special trouble. Such a

heart is not as strong as it ought to be, however, and under sudden or forced action the leak may increase to a point where the ventricle cannot complete the blood cycle, and the person becomes very ill. He may collapse or have heart failure, or he may become chronically ill.

Infection from diseased tonsils or other points in the body often thickens the edges of the valves and produces the same result as dilation, or stretching.

Young persons should by all means have thorough chest examinations by a good physician before and during any form of sports. They should also have a yearly health examination and keep the throat and teeth free from infection. If teeth become diseased, they should be removed by a dentist. Diseased tonsils should be removed by a specialist.

143. Blood pressure. The effort which the heart must make to send the blood around the body and back again is in part dependent upon the size and the elasticity or stiffness of the arteries. If the arteries are relaxed and hold too much blood, the heart has hard work and the person is said to have low blood pressure. If the walls are stiff because of some irritating substance in the blood stream or because there is too much lime in the arterial wall, the heart also has a hard time, and the person is said to have high blood pressure. In this case he is apt to have hardening of the arteries.

Low blood pressure may be a sign of fatigue or ill health at any age. High blood pressure occurs chiefly in middle-aged and elderly persons who have neglected the hygiene of food, exercise, and sleep in their younger years.

144. Encouraging surface circulation. Wetting the skin with cool or cold water squeezes the blood and lymph out of the surface and hastens the return of the venous

blood to the heart. Rubbing hastens the return of blood to the surface. The heart must therefore pump more new blood into the tissues. One must breathe faster and deeper to supply the new demand for oxygen. One has a sense of freshness, warmth, and renewed energy. It is an excellent thing to start every day with a cool sponge bath. It helps to prevent colds, replaces the waste in the tissues, and gives one a joyous sense of well-being.

Try This

Most of the statements in this list are wrong, but a few of them are right. Each wrong statement is untrue because of some word in it. On a sheet of paper write a list of the numbers of the sentences which are correct. Write the other sentences, substituting the correct words for the incorrect ones. Let the class discuss each statement and decide what the word ought to be. How many of your decisions were right? How many did you get right without rereading this chapter?

1. The ameba is a one-celled plant.
2. There are billions of living cells in the human body.
3. The living part of a cell is called protoplasm.
4. The warmth of the body is maintained by osmosis.
5. The cells have many sense organs.
6. Blood surrounds the cells.
7. All the lymph finally finds its way back into the blood stream.
8. The air cells are called bronchi.
9. As the blood flows through the lungs it gives up its wastes to the air in the cells and takes up carbon dioxide.
10. The heart is like a force pump.

11. Valves in the heart and blood vessels prevent the blood from flowing back.

12. The pulmonary vein carries impure blood.

13. Sugar in the blood causes it to clot.

14. The capillaries connect the lymphatics and the veins.

15. Plasma is the substance in the blood which carries oxygen.

16. The red corpuscles eat up disease germs.

17. As one overcomes a disease the white corpuscles increase.

18. Blood should be transfused or carried over from one person to another only when the blood matches.

19. Diseased tonsils sometimes lead to anemia.

20. Diphtheria may be prevented by nutrition.

21. It is desirable for everybody to have a health examination by a physician every three months.

22. High blood pressure occurs chiefly among young people.

23. Low blood pressure is usually a sign of good health.

24. Good health requires the cells to work together.

Interesting Things to Do

1. Get a heart at the market and dissect it. Find the auricles and ventricles and as many other things described in the chapter as possible.

2. Consult a biology and find out all you can about the blood circulation of some animal, as, for example, a fish, earthworm, or grasshopper. Make drawings on the blackboard and report to the class.

3. Try to find out whether there are any other ways of demonstrating the process of osmosis besides the one suggested in this chapter.

CHAPTER XI

HEALTHFUL AIR

145. The results of bad ventilation. It is a matter of common observation that when people are confined in a room or other place where there is little change of air, they soon become uncomfortable. If this is continued for a long period of time, they become ill and may finally lose their lives.

One of the most gruesome tales that have come to us from the past is that of the "Black Hole of Calcutta." One hundred and seventy-six Englishmen were confined in a dungeon by a native ruler of India. Almost all of them were found dead in the morning, having apparently died in the greatest agony. The case of the steerage passengers on the *Londonderry* is almost as striking an example of death from lack of ventilation. The captain of this ship ordered all passengers to go below in a storm. All portholes were ordered closed and all passages leading to the deck were fastened and locked. Some of the passengers survived and told the story of their sufferings, but most of them perished.

146. The explanation formerly given. As men became more familiar with the composition of the air and with the body's needs they came to the conclusion that the ill effects of bad ventilation were due to a lack of oxygen and to an increase in carbon dioxide and other poisons. Here are some of the facts, well known to scientists, which would naturally lead to this conclusion.

The air is a mixture of several gases. They do not combine into one gas chemically, but each gas remains distinct. These principal gases are oxygen (O), carbon dioxide (CO_2), and nitrogen (N). At sea level they occur in these proportions by volume: 21 per cent of oxygen, 78 per cent of nitrogen, and .03 per cent of carbon dioxide. The remaining 1 per cent is made up of other gases in quantities so minute as not to be important in our study.

Chemical tests of the air show that when there is less than 16 per cent of oxygen in the air, most persons have difficulty in breathing. This condition is soon reached by mountain climbers, for the nitrogen is thin and light, and the oxygen is thicker and heavier. As one ascends, then, to a higher elevation the oxygen in the air decreases. At a height of 5000 feet the oxygen concentration is 17.5 per cent; at 10,000 feet, 14.2 per cent; at 13,000 feet, 12.7 per cent. Most people begin to feel uncomfortable symptoms of "oxygen starvation" by this time. In ascending very high peaks, like Mt. Everest, the climbers take oxygen tanks along with them. Aviators frequently fly at 20,000 feet. People differ greatly in their power to live in rarefied air. One of the tests given to would-be aviators deals with this power. Heights have been recorded of 38,539 feet and 42,470 feet in airplane and balloon flights. Some aviators have flown so high that they were obliged to carry a supply of oxygen for their motors.

From such observations scientists concluded that frequent change of the air in rooms, particularly in public buildings like schools and churches, was necessary for healthy living. Most states passed laws requiring that 30 cubic feet of outdoor air per pupil should be forced into

a schoolroom per minute. This seemed like ideal ventilation. It was impossible to secure this change of air by window ventilation, so a mechanical process of forced ventilation came into use.

147. Recent discoveries about heating and ventilating. Scientific men are always experimenting, and as a result of such experiments they have come to new and different conclusions as to what constitutes healthful air. One method of investigation was to inclose people in air-tight cabinets and find out what happened. Dr. Paul found that when the temperature of such a cabinet was 60 degrees the inmate could stay in the cabinet for four and a half hours without noticeable symptoms, although the amount of oxygen became far lower, and the carbon dioxide far higher, than was found in the worst-ventilated rooms; but when the temperature was increased to 72 degrees, it was only a few minutes before headache, mental dullness, and faintness were noticed, and the body temperature rose 3 degrees. When an electric fan was started, these symptoms disappeared.

Another experimenter, L. Hill, found that a person could stay in one of these air-tight cabinets and suffer no discomfort, even when the carbon dioxide was twenty times as great as in badly ventilated houses, if the air was kept cool and in motion. In such an experiment Hill discovered that the oxygen was so low that candles would not burn and cigarettes could not be lighted. But when the temperature of the air was suddenly increased by means of an electric stove, the feelings of distress occurred immediately. When electric fans were started, there was instant relief.

Hill also found that when guinea pigs were kept cool, clean, and dry, they seemed to be healthy even when

confined in tight cages where the carbon dioxide was twenty or thirty times as great as in ordinary air.

Hill also discovered that when a person was in an air-tight cabinet, suffering from hot, stale air, he experienced no relief when he breathed fresh air through pipes. On the other hand, persons outside breathed the stale air inside the cabinet without any ill effects. Lower temperature and electric fans alone brought relief to those confined within. This can be easily understood. As one's temperature increases, the body is covered with perspiration, which evaporates and cools the body. As this moisture around the body increases, it is like a steam jacket which prevents evaporation. The electric fan sets the dead air in motion, increases the evaporation, and cools off the body.

148. What is good air? This is an important question. Because of the many experiments carried on by scientists, good air is found to have these essentials:

1. The temperature should not be above 68° F. if it is cooler than this outside.
2. There should be a good circulation of air without cold drafts.
3. The air should be clean and free from dust and dirt so far as possible. Often neighboring industries contaminate the air so that it is not fit to breathe. Dry sweeping and feather dusters may make the air unfit for breathing.
4. Outdoor air is the best kind of air. Indoor air should be as much like it as possible. Indoor air may be too dry. This has an irritating effect on the nose and throat.

From these experiments it is clear that it is not the condition of the air which we breathe but the temperature of the air which touches the body that is primarily important in ventilation. We now know that the men

in the Black Hole of Calcutta and those on board the *Londonderry* really died from excess heat.

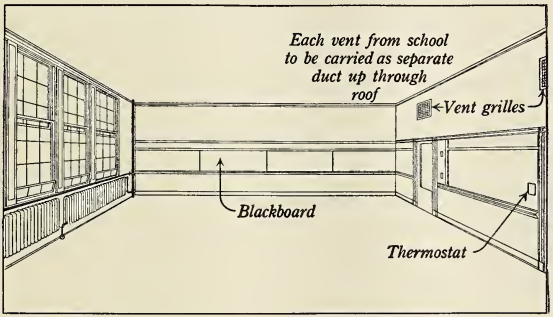
149. Window ventilation. The New York Ventilating Commission made a careful study of ventilation in schoolrooms and found that the health of children in rooms that were mechanically ventilated, so that the air was rapidly changed, seemed to be inferior in some respects to that of children in rooms that were ventilated by windows. Children in window-ventilated rooms were freer from colds and had better attendance at school.

Window ventilation is not found to be very successful in schoolrooms unless there are ventilating flues. These should be placed opposite the windows. If gravity exhaust is provided with window ventilation, the degree of temperature, the amount of air movement, and the amount of humidity necessary for schoolrooms may be provided.

Nearly all homes have window ventilation. In every house it is desirable now and then to have a good airing out by opening the windows at the top and bottom. Everybody should form the habit of sleeping with windows open at top and bottom, so as to get a free circulation of air. This should enable one to get several hours of fresh outdoor air. Play and recreation should give us all a few hours for breathing air in the great outdoors itself.

150. Heating in homes. There are many ways of heating homes, each having certain advantages and certain disadvantages. The fireplace was the means of heating in colonial days. Even the cooking was done over the coals. The fireplace is common in houses today; it is not an economical means of heating, because most of the heat goes up the chimney, but it does provide excellent ventilation and a center for family gatherings and comradeship. Stoves lack the convenience of a steam, hot-air,

or hot-water heating plant. They are rather inconvenient, and, because wood and ashes must be transported through the house, may be dirty and even dangerous. The hot-air system provides for a circulation of air, but, because of the ease with which noxious gases may be diffused through a house, it may be slightly dangerous. A hot-air furnace is quite satisfactory in mild weather and



INTERIOR OF ROOM OF MODERN HIGH SCHOOL

Observe that the radiators extend under open windows. Do you know why? Where are the ventilating flues? Why?

offers an opportunity to humidify the air, since there is usually a water pot above the fire pot, which gives off moisture to the ascending air. A hot-water heating system has the advantage of giving steady heat. Steam heat is usually more irregular than hot water, but can be more rapidly controlled.

151. Living in the air. We have already noticed that the body, to keep physically fit, must have the right temperature, and that this is determined in part by the air that surrounds the body. To maintain the right

bodily temperature, 98.6° F., the human machine makes some interesting adjustments. Good health also demands that we breathe air, and that this air shall be clean, shall be free from injurious bacteria, and shall contain a certain amount of moisture. Let us see how the body protects itself and adjusts itself to the ocean of air that surrounds us.

152. How the body keeps a constant temperature. Everybody knows that the temperature of the body is important. When we are ill, one of the first things that the doctor does is to take our temperature. If it varies a degree or so from normal, it is not only a sign of illness but helps the doctor to find out what the trouble is.

The body, like an engine, is kept warm by combustion. When we exercise strenuously or the weather is hot, the body may be overheated and we begin to feel very uncomfortable. Immediately the body starts to get rid of the surplus heat. There is a relaxation of the blood vessels on the surface of the body, so that they become gorged with blood. Possibly you have noticed that on a hot day your hands seem to swell and the blood vessels stand out. The blood gets rid of some of its excess heat in much the same way as a hot pipe loses its warmth to the surrounding air. At the same time messages go from the nervous system to the sweat glands, which now begin to pour out perspiration on the surface of the skin. As this is evaporated the body is cooled. You have noticed that even a bit of warm water on the skin begins to feel cool as it evaporates. Heat is also lost through the breath.

When the temperature of the body goes below normal, the blood vessels at the surface of the body contract, the blood is driven to the internal organs, and the loss of heat

is checked. Perspiration also ceases. If the body is still too cool, we shiver involuntarily. This is an interesting defense by the body. When we shiver, the muscles contract, and heat is produced. Shivering is a danger signal. It means that we are likely to take cold. We should exercise or put on more clothing.

One of the purposes of clothing is to help control the normal temperature of the body. Wool, for example, is warm because it conducts heat away from the body slowly. Cotton is cool because it is a good conductor of heat.

153. The air route. Dry, dusty, infected air is a menace to health. As it is drawn into the lungs through the process of breathing, nature provides a defense against all these conditions.

The air first enters the nose, where it is safeguarded by the structure of the nasal passages. Each side of the nose is filled with fine scrolls of thin bone (the turbinates). These are covered with the thin, moist mucous membrane which covers the inside surface of the nasal passages. The mucous surface is greatly increased by the shape of the nasal chambers. The abundant supply of blood vessels in these walls warms the air, which might otherwise be too cold for the delicate lining of the air route. The mucous membrane secretes a sticky, slightly antiseptic fluid, or mucus, to which adhere particles of all sorts, including germs that would otherwise make their way into the lungs. If the air is too dry, and hence irritating to the delicate membranes of the breathing passages, this moisture will also humidify the air.

If you will follow this route by means of the illustration on page 175, you will notice that the air passes into the back of the throat; then, through the opening called the glottis, into the windpipe (trachea), and thence into the

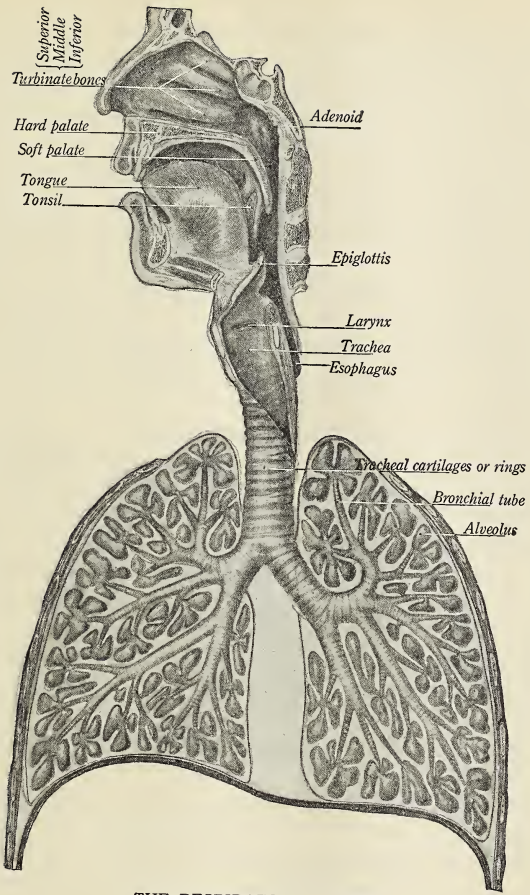
lungs. The top of the windpipe is expanded into a voice box, or larynx, across which are stretched two folds of thin membrane called vocal cords. The top of the trachea is covered with a flap (the epiglottis) where it opens from the mouth cavity. This protects it from particles of food which might go down the air passages. Since the food passage and the air passage both open downward from the mouth cavity, the windpipe being just in front of the esophagus (food pipe), it is necessary that there be this provision for automatically closing the air passage when food is being swallowed. Once in a while, when you take a breath while food is in the mouth, the food "goes down the wrong way" into the glottis while this flap is being raised to allow this passage of air. The discomfort is so acute that the muscles contract to cough it out.

The fine, hairlike projections (cilia) in the air passages of the lungs keep up a constant waving motion toward the nose and mouth, and thus help to remove solid particles that have been breathed in.

It is interesting to know that the windpipe (trachea) and its larger branches (bronchial tubes) are made of rings of cartilage (gristle) like a flexible gas pipe. These rings have the same function as the rings in gas pipes, and keep the air from being shut off by the sharp bending of the tube.

If bacteria, like the germs of tuberculosis, get as far as the lungs and enter the circulation, the white corpuscles are ready to devour them. Tuberculosis receives its name from a habit which the white corpuscles have of forming a tough, cheesy covering around groups of the tuberculosis germs. Within these tubercles the germs can do no injury to the system.

154. Tonsils and adenoids. So much is heard today about removing tonsils and adenoids that some people



THE RESPIRATORY SYSTEM

may get the idea that they are entirely worthless to the body. This is not true.

Tonsils and adenoids are glandular tissues. The tonsils are arranged in small masses on either side of the throat. The nasal adenoid tissue is found where the nose and throat join. There is also another very small mass on the back of the tongue, called the lingual tonsil. These glandular masses touch each other when swallowing takes place.

These glandular tissues are covered with mucous membrane and contain many white corpuscles. Tonsils and adenoids help to catch and destroy germs and other impurities. They stand as a ring of sentinels stationed to guard the port of entry to the body.

Often these tonsils and adenoids become dangerous to health. When any part of the body is constantly exercised, it grows larger. The blacksmith's right arm and the enlarged heart of the athlete are good examples. If this glandular tissue is called upon to work all the time to take care of the germs and dust which are constantly inhaled in the air that we breathe, especially if it is repeatedly infected with "cold germs" and irritated by hot, dry inside air in winter, it swells and may break down and become diseased. Then instead of being a protection it becomes a danger, and the blood absorbs poisons which are very likely to produce rheumatism, heart disease, and other ailments.

Diseased tonsils should be under the care of a specialist. If they have careful and constant treatment and are not too badly diseased, they can sometimes be saved. Too often, however, there is nothing to be done but take them out. They should certainly be removed if joint pains or signs of rheumatism appear.

155. Importance of good air and hygiene. From the careful reading of this chapter we see that the kind of air we live in is very important for healthful living. The body, as we have seen, tries to protect us against the evils of bad air which contains dust and germs and may be too hot or too cold. We can help the body in its work by living in good air as much as possible. Outdoor air is usually the best air, and we should try to get as much of it as possible. We can control the heating and ventilating of our schoolrooms and houses. In addition to this we may take precautions to keep the nose, throat, and lungs in a healthful condition by avoiding bad air and colds and also by having medical advice when we need it.

Try This

What is the missing word or words in each sentence?

1. People used to think that illness from bad ventilation was due to a lack of ____.

2. Air is composed chiefly of three different gases: (1) ____, (2) ____, and (3) ____ ____.

3. The correct temperature is about ____ degrees F.

4. Hill found that when a person was confined in an air-tight cabinet he found no ____ when he breathed outside air through pipes.

5. The most important characteristic of good air is its ____.

6. ____ air is the best kind of air to breathe.

7. It is not the air that we breathe but the air that ____ our bodies that is most important.

8. Rooms ventilated by fans seem to be more conducive to colds than rooms having ____ ventilation.

9. The body is kept warm by ____.

10. Evaporation helps to keep the body ____.

11. Clothing made from wool is warm because wool is a ____ conductor.

12. The blood vessels in the walls of the nasal chamber ____ the air.

13. The epiglottis covers the ____, so that food may be guided safely over into the esophagus.

14. The tonsils are stations for ____ corpuscles.

15. Diseased tonsils may cause a disease called ____.

16. It is best to have tonsils ____ by a specialist.

Interesting Things to Do

1. Make a study of your own school ventilating system.

2. Make a study of your heating and ventilating system at home.

3. Make a study of the process of respiration in some lower form of life, such as fish, frogs, or earthworms. Put drawings on the board and explain to the class.

CHAPTER XII

HOW FOOD IS DIGESTED

156. The wonders of digestion. None of the miracles performed by the human body are more remarkable than the process of digestion. Every day we consume quantities of food, which, through a process of digestion, is prepared for the use of the cells of the body. Think of the miracle by which milk, bread, lettuce, spinach, potatoes, and meat are received by the body and turned into bone, flesh, action, and thought. The digestive system consists of two groups of organs which prepare the food to do this work, — the alimentary canal and the digestive glands.

157. The alimentary canal. The alimentary canal, as we see in the illustration on page 181, consists of a long passageway for the food. It begins with the mouth cavity and ends with the large intestine. This canal is a long tube, with one greatly expanded section, the stomach. The walls of the tube are chiefly circular muscle fibers. The parts that have the most movement to perform have also a layer of the same sort of fibers arranged lengthwise outside the circular ones. The stomach, which has the hardest muscular work to do, has still another layer over part of it, running obliquely. The whole length of this tube is lined with a very delicate membrane which secretes a smooth, sticky mucus. This mucus lubricates the passageway so that the food slips through easily.

158. The first process in the mouth. The mouth receives the food, grinds it up into fine particles, and mixes it with

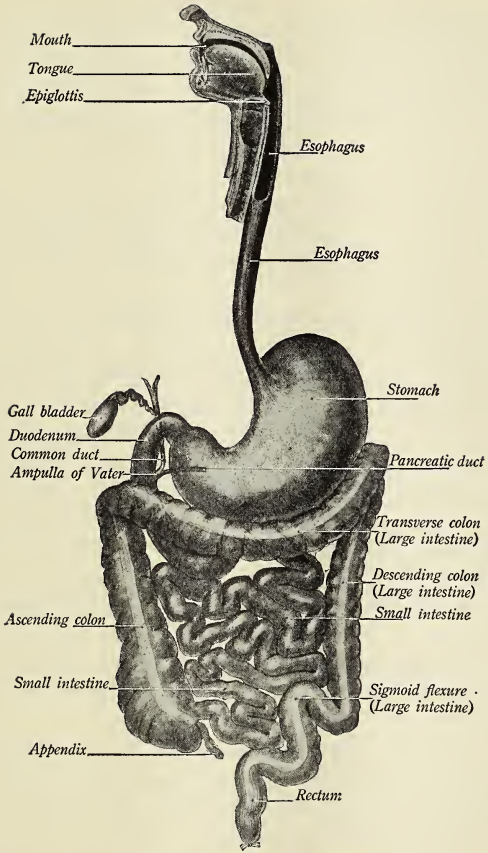
mucus and saliva. It passes it on, by the voluntary act of swallowing, into the esophagus, or gullet, — a narrow section of tubing 9 or 10 inches long. Its walls are thin and elastic, with only a few weak muscle fibers. Since the food is forced into the gullet by swallowing, and is lubricated by the mucus, its downward course is easy, occupying about five seconds.

159. Digestion in the stomach. The enlarged portion of the alimentary canal, into which the esophagus opens, is the stomach. Its large end opens, through a valve, from the esophagus, and the small end opens, through another valve, into the small intestine.

The walls of the stomach differ from those of the rest of the canal in two respects: the muscular layers are particularly well developed, and the inner lining is full of tiny pockets, called gastric glands. These secrete the gastric juice, which helps digest the food. The stomach is shaped as you see it in the drawing; in an adult it holds about two quarts.

160. The work of the small intestine. The small intestine is a long, coiled section of tubing, about twenty feet long and from three fourths of an inch to an inch across. It has two layers of muscles along its whole length. These muscles are very important, since the food must be kept moving through these coils of tubing, up, down, or crosswise, without any reference to gravity.

The way in which these muscles work is one of nature's favorite plans. The outside layer of muscles — those running lengthwise — contract just ahead of food entering from the stomach. This makes the tube shorter and broader just ahead of the food. The circular muscles underneath take up the contraction as soon as the longitudinal ones have finished, and by their contraction make



THE DIGESTIVE SYSTEM

the tube behind the food smaller, shoving it ahead into the larger space prepared by the previous contraction of the longitudinal muscles. This double wave of contraction, the outer just preceding the inner, runs the whole length of the small intestine, shoving the food along much as you would shove a marble through a rubber tube with your thumb and finger.

The small intestine differs from the stomach chiefly in shape and in the absence of the oblique muscles. The lining contains minute glands which secrete another digestive fluid.

The chief difference between the small intestine and all the other sections of the alimentary canal consists in the way the area of the inner lining is increased to provide absorbing surface sufficient for taking up all the food supply into the blood stream. The whole membrane is covered with minute projections like innumerable small glove fingers, making the inner surface of the intestine resemble velvet. Each finger (from one fiftieth to one eighth of an inch long) is called a villus, from a Latin word for "hair." Each villus, as you can see by consulting page 189, contains capillaries and a lymphatic, called a lacteal. The food, which has now been prepared for absorption, passes through the thin walls of the capillaries and lacteal and so finds its way into the general circulation.

161. The work of the large intestine. The last section of the alimentary canal is the large intestine, larger around and shorter than the small intestine. Its walls are made up of the same two muscular layers, but the inner layer is smooth, because most of the digested food has been absorbed into the blood, and only the solid waste matter and water are left.

At the junction of the large and the small intestine is the appendix, — a small remnant of what was, in the lower vertebrates, a usable part of the intestine. It is frequently the seat of infection. The resulting inflammation called appendicitis often makes the removal of the appendix necessary.

162. The digestive glands. The principal digestive glands, in the order in which they pour their secretions into the alimentary canal, are the salivary glands (three pairs), the gastric glands, the pancreas, and the liver. The mucous glands are not strictly digestive glands, but they keep the passage moist and smooth, so that the food slips along easily, and for this reason they are included here.

SALIVARY GLANDS

a and *c*, two of the glands that manufacture saliva; *b* and *d*, ducts that carry saliva to the mouth; *e*, the tongue

A gland is an organ which takes materials from the blood and makes from them a new substance, — a secretion. This secretion is then passed through a duct into any part of the alimentary canal that needs it. The glands without ducts will be discussed later; the glands with ducts are those now being considered. They are the best known because their secretion is perfectly obvious and easily studied.

The gastric glands are the simplest; the liver and pancreas seem the most complicated, but this complication is only apparent. The liver is only a large mass of simple glands.

163. The work of the digestive glands. The chief function of the glands is to manufacture enzymes. The name

enzymes is given to certain products of living matter which, thus far, like electricity, are known only through their behavior. There is believed to be a separate kind of enzyme for every life process. While enzymes have not been isolated, a great deal is known about their action. Their most distinguishing characteristic is their ability to cause a practically unlimited amount of change without themselves being affected by the change or being used up.

The simplest glands (the mucous and the gastric) are finger-shaped pockets projecting inward into the lining of the alimentary canal and covered with a layer of cells. By osmosis the fluid blood plasma pushes out of the capillaries into the denser protoplasm of the gland cells, through their cell membranes. Each of these cells serves as a chemistry test tube in which the materials selectively absorbed from the blood are recombined into a new substance — a secretion — and poured out into the space in the middle of the gland. This communicates directly with the alimentary canal by a duct or, in the very simple ones, by a mouth. The illustrations on pages 222 and 223 show how all glands are really built on the same principle.

The mucous glands secrete a slimy, watery fluid which is the lubricant of the body, just as oil is the lubricant for any machine. All surfaces of all organs are thus protected.

The salivary glands add to this mucus the enzyme for changing starch into sugar.

The gastric glands secrete gastric juice, which starts the digestion of proteins and prepares casein for digestion farther on. The acid in this juice softens up the fibrous parts of the food, so that the digestive fluids can penetrate.

The pancreas supplies the really important fluid which finally digests all three classes of foods, — carbohydrates, fats, and proteins.

The liver secretes bile, which is stored up in the gall bladder to be used after each mealtime in the digestion of fats. Being alkaline, it helps in breaking up the fats into finer particles, which can be absorbed into the circulation by osmosis. This is by no means all that the liver does; bile is partly a waste product which thrifty Mother Nature has found a way of making useful in the course of its excretion.

There are two other uses of the liver:

1. It turns excess sugar into an almost insoluble storage form called glycogen or animal starch. Sometimes the liver contains as much as six ounces of this reserve, stored in solid particles of glycogen in the cells. In case of a scarcity of sugar in our diet some of the glycogen is redissolved and absorbed into the blood. This helps to keep the supply of sugar in the blood even, — about 0.1 per cent.
2. It takes care of excess and waste protein foods by splitting them up and changing the nitrogen to urea, which is passed on to the kidney, where it is removed and excreted in the form of urine.

The liver is large because it has to regulate the proportions of energy foods and building foods that are supplied to the cells by the circulating blood stream, and also because it has to store up and dispose of the excess of unused food material.

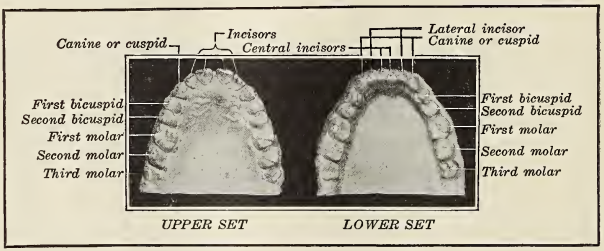
164. The teeth. Before digestion can begin, the food must be ground up into fine particles, so that the enzymes can reach it all. This is done by the teeth.

There are thirty-two human teeth, as you will see in the picture. The incisors and canines are adapted for cutting the food and the molars for grinding it.

The tooth is covered with the hardest substance in our bodies, — enamel. Inside is the dentine, more porous,

and inside this a pulp containing blood vessels and nerves. The root has no enamel over it, but is covered with a less resistant cement. Through the tips of the roots the blood vessels and nerves enter the tooth.

If you count your own teeth, you will not agree with the statement that we have thirty-two. The last four molars (one on each side above and below) do not come



A MODEL OF A COMPLETE SET OF TEETH

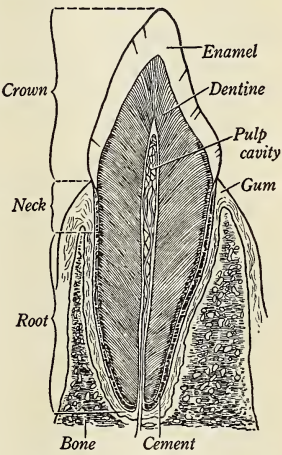
Find the six-year molars. Look at your teeth in the mirror. Can you identify each tooth by name?

until about the age of eighteen years, and therefore are called wisdom teeth. The second pair of molars ordinarily come in at twelve years (sometimes a little earlier or later), and the first pair at six years.

These six-year molars are of the greatest importance, because they are the first of the permanent teeth to appear and are located so that they set the form of the arch of the jaw. These are sometimes called the keystones in the dental arches. If they decay and have to be extracted, a misshapen mouth results. Of course, all the temporary teeth should be well cared for, but these first permanent ones, being below the level of the others while coming in, are particularly hard to keep clean.

The importance of sound teeth cannot be overemphasized from the standpoint of health, appearance, and comfort. Good teeth are not something that nature gives or withholds, regardless of our effort; they are the result of the intelligent application of facts now known by almost everyone.

Building sound teeth. The hard part of the teeth is made of minerals, chiefly calcium (lime) phosphate. To build teeth we must eat food containing the material of which they are made. This is the first rule in the hygiene of the teeth. There is no other way. Calcium phosphate occurs in many foods, but in one only are we certain of it in sufficient amount and in the most digestible form, — milk. A quart of milk a day will insure enough calcium phosphate for sound bones and teeth.



CROSS SECTION OF A TOOTH

But the building of good teeth begins long before we are capable of planning intelligently for ourselves. The mother must eat the right foods both before the child is born and while she is nursing the child, or his teeth will be weak in spite of the best care he can give them later on.

After we supply building food for teeth we avoid injuring them and let them grow. Teeth that grow in unhealthy, undernourished bodies are apt to be poor in quality and to wear and crack easily. They are porous and easily form cavities. The poison from decayed teeth

is taken up by osmosis into the capillaries and carried over the body, often causing serious illness. These carious (decayed) teeth thus become the foci of infections which may cause neuritis, abscesses, or infections in the appendix, kidneys, joints, or eyes.

Care of the teeth. The second rule in the hygiene of the teeth is cleanliness. The teeth should be brushed with a mildly alkaline dentifrice at least twice a day. Precipitated chalk, powdered soap, milk of magnesia, a mixture of soda and salt, and the unsweetened pastes and powders are all good.

Exercise. The third rule for the hygiene of the teeth is exercise. When muscles work hard, the blood which supplies the extra oxygen for the energy expended also carries food to make good the waste and to provide for additional growth. So teeth, when exercised by chewing hard and fibrous foods, require more blood, which in turn carries more of the tooth-building material from our foods. Young children should chew hard crusts in order properly to spread the teeth or space them in the jaw.

Healthy teeth, then, require, each day, (1) as much calcium phosphate as a quart of milk contains; (2) protection from decay by bacterial action and from injury by accident; (3) exercise, so that the blood will be sure to bring the food in the circulation to the roots of the teeth.

165. Summary of digestion. *In the mouth.* While the food is being chewed it is mixed with the saliva, and as the particles become dissolved they are tasted by the taste buds on the tongue. Food tastes better for being well chewed. It is meanwhile being acted upon by the enzyme in the saliva, the insoluble starches being changed to sugar, which dissolves in water and can therefore be taken up into the blood. As each mouthful is sufficiently chewed

it slips down without conscious effort. A piece of red litmus paper held in the mouth turns faintly blue, showing that the saliva is alkaline.

In the stomach. As soon as food enters the stomach the muscular walls set up a gentle churning motion by which it is thoroughly mixed with the acid gastric juice. Then the work of digestion of proteins is begun, and the fibrous parts of the foods are softened up. A little of the food is absorbed into the fine blood vessels here in the stomach, but most of this work of absorption is done in the next part of the food canal, — the small intestine.

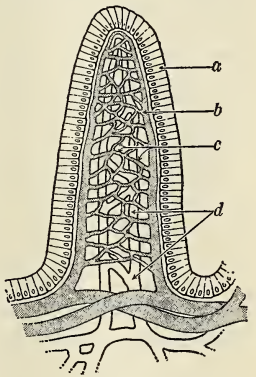


DIAGRAM OF A VILLUS

a, layer of mucous membrane formed of cells which absorb food and carry it to the tubes within; *b*, an artery; *c*, capillaries; *d*, lacteal

In the small intestine. Here the proteins, sugars, starches, and fats are all mixed with the digestive fluid from the pancreas. This pancreatic juice contains three enzymes, by which are digested all three classes of foods,— starches and sugars, proteins, and fats. Here the bile from the liver helps to prepare the fats for digestion. The dissolved foods are soaked up (absorbed) by osmosis into the tiny capillaries which are contained in the villi along the walls of the small intestine. The blood then carries the dissolved foods all over the body, and each kind of cell absorbs from the blood stream the particular food material which it needs.

In the large intestine. The indigestible parts of the foods and much of the water are passed on into the large intestine, from which the water is absorbed into the blood.

166. Excretion of waste. The indigestible solid refuse from the foods is passed on through the large intestine and excreted through the opening to the exterior called the anus. The unused food elements that have been absorbed into the blood are excreted as urine by way of the kidneys, through the bladder, and out through the short tube called the urethra. A small amount leaves the body through the sweat glands in the perspiration.

The hygiene of elimination. The disposal of waste is important, since its accumulation in the system has much the same effect as the collecting of ashes in the furnace or of carbon around the spark plugs of your car.

Fortunately we do not have to learn any new things to do in order to insure efficient disposal of wastes. Cleanliness, internal and external, already a matter of course from our standards of good taste, takes care of the matter. We should eat much roughage, — coarse cereals and fibrous vegetables and fruits. These act just like scrubbing brushes that are being gently squeezed through the food passages, keeping the undigested food from lodging and decaying in the folds of the intestines.

Drinking plenty of water and exercising vigorously should insure proper elimination of the liquid wastes through the kidneys and sweat glands.

Review and Thought Questions

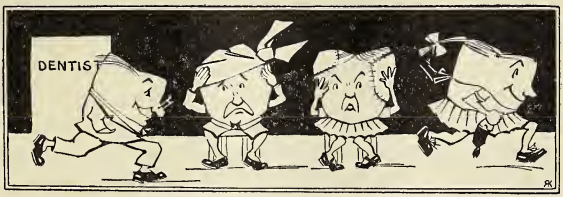
1. What takes place during digestion?

2. Describe in the case of an engine the process which is similar to digestion.

3. What two groups of organs make up the digestive system?

Caring for Teeth

1. You need your teeth to chew your food, keep you well, and to help you talk — so give them the best of care.
2. To keep them clean you must have:
   a. Food that is hard to chew.
   b. A good small brush of your own like this ☞
   c. Toothpaste or powder that is not gritty.
3. Each day you should:
   a. *Brush* your teeth twice, once with toothpaste.
   b. *Brush* your teeth carefully up and down.
   c. *Brush* all sides of your teeth and your gums.
   d. *Pass* dental floss between teeth that are close together.
   e. *Rinse* your mouth thoroughly with salt and water or lime-water. You can get lime and directions at a drug store.
   f. *Wash* your brush in hot water and hang it to dry in the sun if possible.
   g. If it is matted or soiled buy a new one.
   h. *Look* at your teeth in the mirror to be sure they are clean.
4. You cannot take care of your teeth alone. Go to a Dentist regularly twice a year.



SUGGESTIONS FOR CARING FOR THE TEETH

Read them carefully. They were prepared by a council of dentists

4. What digestive process takes place in the mouth? in the stomach? in the small intestine? in the large intestine?

5. Where is most of the nutritive material absorbed?

6. What is a gland? What are the chief glands of the digestive system?

7. How can we keep the mouth in a healthy condition?

8. Give all the reasons you can why good teeth are valuable.

9. In what ways may the body get rid of wastes?

10. Give all the reasons you can for going to a dentist twice a year.

Interesting Things to Do

1. Write to your city or state department of health for printed matter on the care of the teeth.

2. Some schools, in preparation for May Day, try to have 100 per cent perfect teeth. Try to encourage 100 per cent of the children in your room to see the dentist regularly.

CHAPTER XIII

THE SCIENCE AND ART OF NUTRITION

167. What the body is made of. In order intelligently to care for any machine it is necessary to know of what it is made. The universe is made of about ninety simple kinds of material; for example, iron, oxygen, and gold.

The human mechanism is composed of about twelve of these elements, with traces of others.

Oxygen	O	Sulfur	S
Carbon	C	Chlorine	Cl
Hydrogen	H	Iodine	I
Nitrogen	N	Potassium	K
Calcium	Ca	Sodium	Na
Phosphorus	P	Iron	Fe

These are called elements because they are the simplest form in which matter can occur; they cannot be separated into component parts, as, for example, water can. Iron is simply iron, while water can be separated into two elements, hydrogen and oxygen. Its abbreviation, or formula, is written H_2O. This means that there is twice as much hydrogen as oxygen in every particle of water.

168. Plants as a source of food. Although we know that our bodies consist of these few simple elements, we ourselves cannot utilize these nonliving (inorganic) materials as food. Although a grown man's tissues contain enough iron to make a tenpenny nail, we cannot eat iron. A middleman, the green plant, takes nonliving materials of the air, water, and soil and manufactures from them the

organic foods which we eat. We then use for food the plant tissues and those of some animals that have in turn eaten plant food. So, ultimately, all animal life depends for food upon plants which make it out of earth, air, and water.

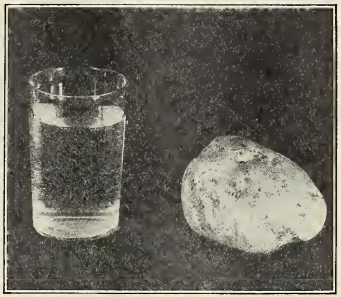
169. Meaning of nutrition. The sum of all the processes by which these food materials are built up into our living bodies is called nutrition. It might seem, at first thought, that all there is to proper nutrition is to find out the necessary elements and to eat foods that contain the proper proportion of these elements. But nutrition includes far more than supplying the body with food. It includes first, of course, the taking in of food; second, the mechanical and chemical changes by which this food becomes dissolved and ready for use by the cells; third, the absorption of this prepared food into the blood vessels; fourth, the circulation of the blood, which carries the food to the tissues; fifth, the assimilation of these food materials into new cell material either in growth or, after growth ceases, in the repair of worn-out cells. Part of the food assimilated by the cells goes to supply energy for growth and repair and for the specific activity of those cells, — for example, the contraction of muscle cells and the conduction of nerve cells.

© Henry Miller

A GREEK BOY AT HOME

He is selling fresh fruits and vegetables

170. Essentials of diet. 1. *Water.* In order to dissolve foods, water is necessary. This is the first reason for an abundance of water in the diet. Second, we have seen that no chemical action can take place if the compounds or elements concerned are perfectly dry. Third, waste matter must be in solution in order to be removed from the body. The sweat glands alone give off, in the form of perspiration, from one to three pints of water a day, with waste matter in solution. The kidneys give off about three pints of water daily in the form of urine, which carries off another kind of waste product.



FOODS CONTAIN WATER

The glass and the potato contain the same amount of water

The maintaining of the water balance of the tissues is therefore most important. Enough water must be taken in food and drink to maintain this water balance in the tissues and to carry off waste products. Fortunately we do not need to worry about drinking too much water. Estimates of the amount of water that should be drunk vary widely, and it is well to be on the safe side and drink plenty. The one rule to be observed is that we do not wash our food down with drink instead of chewing it until it slips down with the saliva which changes the starch to sugar. In addition to the quart of milk a day and the water which our most solid-looking foods contain, we shall do well to drink at least four glasses a day.

2. *Building material* (*proteins*). The body itself, being chiefly protein, must be built from protein foods. These foods, as we should always remember, consist fundamentally of the elements carbon, hydrogen, oxygen, and nitrogen, the nitrogen being the one element not contained in the other food groups.

Protein should form about 15 per cent of the diet during the years of growth and about 10 per cent in adult years.

PROTEINS ARE BUILDERS

The difference in the proteins fed these rats made the difference in their weights. They were all from the same litter

A few years ago it was considered that all there was to planning the protein part of the diet was to decide how much protein food to eat. It was thought that proteins were proteins, and one as good as another. We used to hear beans and nuts referred to as meat substitutes. Now we know that there are a vast number of proteins and that we must eat a variety of protein foods.

Milk, eggs, and meat are the animal proteins. Vegetable proteins cannot entirely take their place. A vegetarian diet is all right if it is interpreted as excluding meat only. We must have either milk or eggs. Substitutes for eggs may be found, but the yolks are so valuable a source

of sulfur and iron that it is very unwise to try to do without them. It is the general opinion that two or three servings of meat a week help to secure a well-rounded dietary, although it seems pretty well agreed that most families use too much meat.

3. *Energy foods* (*carbohydrates and fats*). These two classes of foods furnish energy for the growth, repair, and specific activities of tissues. The surplus energy that is not completely utilized in growth and in specific activities of the body furnishes heat. These foods contain carbon, hydrogen, and oxygen, as do proteins, but no nitrogen. Like proteins, they contain varying amounts of minerals and of vitamins.

The energy contained in the foods is set free by combustion (oxidation), just as the gas in the engine furnishes driving power when burned. This will be discussed more in detail later, in connection with respiration. For the present it should be clear that a properly planned dietary must allow for a great deal of energy food.

a. Carbohydrates. Carbohydrates are of three kinds: (1) cellulose, (2) starch, and (3) sugars.

(1) *Cellulose* is the form which makes up the fibrous parts of plants. It must therefore be insoluble in the cell sap and, so far as our use of it goes, valuable only for roughage. This, however, is very important. Internal cleanliness demands a considerable bulk of "scrubbing brush" food, which is constantly pushed through the folds of the intestines and prevents the lodgment and decay of food particles. This is one of the reasons for eating an abundance of vegetables and fruits.

(2) *Starch* is the storage form of carbohydrate found in plants. It contains the same elements as the sugars, but the molecules are so large that they must be broken up

into smaller ones in order to be absorbed from the food canal through the walls of the blood vessels. Excess carbohydrate food is taken from the blood in passing through the liver and is stored in the cells of the liver as insoluble grains of glycogen, sometimes called animal starch. This keeps the amount of sugar in the blood always uniform, — about 0.1 per cent. This glycogen is like the extra gallon of gasoline carried under the back seat as reserve in case we run out of gas on an unexpectedly long drive.

(3) *Sugars* are of several kinds. They are classified according to the place they occupy on the way from starch to glucose, which is made up of the smallest molecules. Glucose is the final form into which all starches and sugars are changed to be carried to the cells.

In planning a balanced ration for temperate climates 70 per cent is usually allowed for carbohydrates. Fruits, cereals, and vegetables, along with milk, supply us also with the essential minerals and vitamins.

b. Fats. Fats are interchangeable with carbohydrates, but, as has been said, they are not so readily oxidized and are productive of more heat. Fat is the most concentrated form of energy food. M. S. Rose estimates that three fourths of a pound of fat would, if we could eat that amount, satisfy the energy requirement for a day, and that it would take eight pounds of cooked rice (more than a gallon pressed down) to supply the equivalent. So we do better to take a middle course between the concentrated fat and the bulky starch. A diet with some fat is more satisfying because it digests more slowly and does not leave the stomach with the empty feeling that quickly absorbed foods leave. For this same reason it must be remembered that foods whose particles are coated with fat, as fried potatoes and pie crust, are much less digest-

ible. The fat is dissolved only in the intestine by the bile, and by the time that is done some of the starch contained must be hurried on undigested. For growing children particularly, fats mixed with starches and sugars, as found in pastry desserts, should be avoided.

The average diet in the temperate climates contains about 20 per cent of fat.

Fats cannot be selected for their energy content alone, however. They differ so widely in vitamin content that this must be the first consideration in the choice of fats for food. Butter fat is the most important of all in this respect.

4. *Mineral salts.* In planning the diet we must take into consideration not only the building food and energy requirements but the minerals which enter into the composition of the body, some in one cell and some in another. The percentage of the total daily requirement for calcium, phosphorus, and iron, furnished by an average serving of certain foods, is given on pages 355–360.

Of the entire mineral content of the body, calcium and phosphorus constitute over 70 per cent.

a. Calcium. About 99 per cent of the total calcium in the body is found in the bones and teeth. This is in the form of calcium phosphate, a compound of calcium, phosphorus, and oxygen. The other 1 per cent, however, is distributed widely and to exceedingly good advantage. The blood, for example, cannot clot if calcium is not present in its composition.

Some people do not have sufficient calcium in their blood to bring about clotting. They are called bleeders, and the smallest cut is dangerous if not scientifically cared for. Surgeons always ascertain whether the patient's blood clots normally before performing an operation. If, by chance, they have a bleeder, it is now

a simple matter to inject enough calcium into the circulation to insure temporary clotting.

The importance of calcium in the physiology of the body is also seen in the fact that it is essential to the power of contraction in muscle fibers and to that of response in nerve fibers.

The chief source of calcium in food is milk. It occurs here in its most usable form. If a quart a day is always taken, we are sure of enough of this important element. Adults need about two thirds as much milk as do growing boys and girls.

b. Phosphorus. The element next most abundant is found combined with calcium in the blood and bones and is also an ingredient of all the cells of the body. Its importance, therefore, cannot be overestimated. It is found widely distributed in foods, but the quart of milk insures the right amount, as it does of calcium.

c. Iodine. This is present in the cells in exceedingly minute amounts, yet its importance is evident from the effect produced by its absence. It has been discovered experimentally that when iodine is not present in the drinking-water (therefore not in the sap of the vegetables and fruit grown in the same locality), a disease called goiter is present. Anyone living in a goiter region should eat plenty of sea food, as oysters, clams, or fish, since these live directly or indirectly on sea plants, which take iodine from the sea water. The physicians in these regions will probably advise the use of iodized table salt or the addition of one drop of an iodine solution to a glass of milk once a day. Iodine should be added to the diet only under direct advice of a physician.

d. Sulfur. This element is equally important, being a constituent of all living cells. All protein food, therefore,

contains it. Egg yolk is the most valuable single source of sulfur in our dietary.

e. Sodium. In the form of common salt, sodium is found in all tissues, but particularly in the blood. Here it is indispensable in keeping the blood at the right thickness so that the food can be absorbed into the blood vessels by osmosis.

f. Iron. This is an element of the greatest importance to growth, because it is the element in the hemoglobin with which the oxygen combines. Because of the rapid oxidation in growing cells, the essential structures in actively growing cells contain a great amount of iron. It is necessary to plan definitely for the iron content of food. Egg yolk and spinach and liver are particularly rich in iron. Tomatoes and oranges are valuable for iron as well as for vitamins.

Other minerals are sufficiently common in foods so that if the ration is planned to include enough calcium, iron, and phosphorus (and, in goiter regions, iodine), all the other essential minerals will be found along with them. Green leafy vegetables and milk will supply enough of all these minerals, as well as the vitamins that are essential to growth.

5. *Vitamins.* It is well to understand at the start that, however carefully the amounts of building food, energy food, and minerals are computed and however carefully the diet is planned to include all the elements of the body in the right proportions, we may still fall far short of health, or may acquire serious diseases owing to malnutrition.

About twenty years ago experimentation in several laboratories (particularly Dr. McCollum's and Professor Mendel's) resulted finally in the coining of the word "vitamin" to name these perfectly definite factors which

thus far have not been isolated. They can be located as to their occurrence in foods by trying the effect of foods on the growth and health of animals, but so far no one has ever seen vitamins. Like electricity, they are known only by their behavior. Dr. Rose aptly compares vitamins to the spark which ignites the gas of the automobile engine. It is not fuel or oxygen, but it is essential to the activity of both. For our purposes the first four vitamins discovered are the important ones, since their identity is fully established and their occurrence in foods is known. Experimentation is now under way which indicates that there may be a whole series.

So much interesting recent literature on vitamins is available that only the bare facts needed to enable us to plan a balanced dietary are given here.[1]

The four vitamins most important to know in planning our diet are:

Vitamin A, or fat-soluble A (growth-and-immunity-promoting).
Vitamin B, or water-soluble B (growth-promoting and anti-neuritic).
Vitamin C, or water-soluble C (antiscorbutic).
Vitamin D, or water-and-fat-soluble D (antirachitic).

Vitamin A occurs in fats, particularly butter and cod-liver oil. It is found in the glandular organs of animals. Its abundance seems to vary with the diet of the animal from which the fat is taken. Those fed on foods rich in the same vitamin are correspondingly well supplied. The vitamin content of butter fat is much greater during the time of summer pasture. Green leaves and yellow vegetables, such as sweet potatoes and carrots, are rich in this

[1] E. V. McCollum and Nina Simmonds, Food, Nutrition, and Health. The Lord Baltimore Press, Baltimore, Maryland, 1925.

vitamin. Its absence results in an eye disease which is practically unknown in this country, since even the worst diets are not entirely lacking in this vitamin.

Vitamin B is rather widely distributed. Yeast, whole cereals, and almost all fruits and vegetables are useful sources of this vitamin. Its presence protects against a disease of the nerves that causes paralysis. The growth is retarded or stopped by deficiency of this vitamin.

SUNLIGHT MADE THE DIFFERENCE

Courtesy of Professor E. B. Hart

Vitamin C is called antiscorbutic, because it prevents scurvy, a disease that was known for a long time before its cause was discovered. Long ago it was experimentally found that lemon juice or other citrus fruit added to the diet of sailors on shipboard prevented this disease, which otherwise was prevalent because of the lack of fresh foods. Oranges and tomatoes are especially valuable sources of this vitamin.

Vitamin D was not detected for a long time, because it occurs with vitamin A. Cod-liver oil is particularly rich in this vitamin and is now regarded as an essential food for growing children in winter, when it is not possible for them to spend long hours in the sunlight. This valuable vitamin is formed in the cells of the body from a fatlike substance which they contain, called ergosterol. The lack of sunshine, and hence the lack of vitamin D,

both cause rickets, a nutritional disease of early childhood which shows traces later in the bony structure of the adult.

Ordinary window glass will not transmit the ultraviolet rays of the sun. Within the last few years several kinds of window-glass substitutes have been manufactured which do allow these rays to pass through. In cases of patients too feeble to enjoy outdoor sunshine in cold weather this glass is of great value. Foods grown under this artificial glass have the same vitamin content as if they were grown out of doors in the sun, while those grown under ordinary glass possess it to a much smaller degree or do not have it at all.

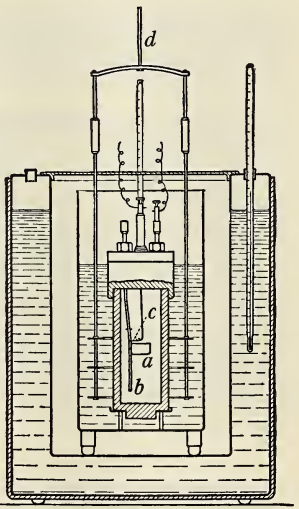
A. F. HESS

American scientist who has done much to show the value of exposure to sunshine as a preventive and cure of rickets. He found that cod-liver oil and foods exposed to sunshine had value similar to sunshine. (Photograph by Bachrach)

In the picture on page 203, from Dr. Ruth Wheeler's "Food and Nutrition," showing the growth of chickens with and without sunlight, we see a remarkable similarity to other pictures of chickens which show similar retardation in growth from the lack of vitamins in the diet.

The table of food values in the Appendix shows the distribution of vitamins in certain food materials.

This chapter has given us the main facts by which we can determine what to eat. We have seen that intelligent food selection must include consideration of (1) the chemical composition of foods (whether protein, or carbohydrates, or fats) and the mineral content; (2) the vitamin content; (3) the water balance. We have still to consider how much to eat.

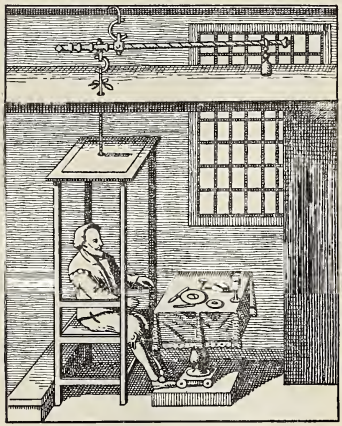


A BOMB CALORIMETER FOR DETERMINING THE CALORIFIC VALUE OF COAL

171. How much do we need to eat? The unit of measure of the value of food to the body is called the calorie. This, as the word indicates, concerns heat. It would be an obviously impossible task to measure the energy required for each organ to do its work. A very clever solution of an apparently impossible problem was hit upon in the calorimeter (heat-meter).

This is a closed steel vessel filled with oxygen, through which a current of electricity is passed. The food to be measured is inclosed in this vessel, called a bomb, and the bomb is immersed in water. The food is burned in the oxygen by the electricity, and the heat given off by the burning of the food warms the water around the bomb. The temperature of the water is measured by a thermometer. Some

foods give more heat than others. The amount of heat which is needed to raise one pound of water about 4° F., or to raise one kilogram of water 1° C., is called a large calorie, a familiar term in the study of nutrition.



SANCTORIUS (1561–1636)

An early student of nutrition. In the balance above he was able to test his weight under different conditions. He showed that the body lost weight by mere exposure, or what he called insensible perspiration

This is used as the unit of measure of the work that food does in the body, since the work done increases with the heat given off.

Very careful measurements of the calorific value of different foods have been made by experts, and tables have been prepared. In computing the amount of foods needed the table in the Appendix will be sufficient. Much longer lists can be obtained from the United States Bureau of Agriculture.

It is a dangerous thing to try to determine how much food one needs by calories. Growing boys and girls need far more food than do adults. Growth proceeds at different rates for different persons. The ability to utilize food is very different. Some people assimilate much more of a given meal than do others, and therefore need to eat less food than one who does not get so much value from what he eats. Estimates by author-

ities on nutrition vary from 3000 to 5000 calories a day for boys of junior-high-school or high-school age. Estimates for girls are usually lower, because in general girls are less vigorous in their muscular activities.

The only safe rule for growing boys and girls is to eat all that the appetite requires. Four conditions must be met: (1) The food must be the right kind of food, as to both selection and preparation. (2) It must be thoroughly chewed. (3) It must be eaten under favorable conditions: (*a*) unhurried, (*b*) cheerful. (4) Most important of all, the diet must be considered as one element of a daily program which includes a sane balance of food, activity, and rest.

In planning your dietaries it must be understood that each day's program should include four hours of big-muscle activity, at least two of them out of doors, and at least ten hours of sleep, — more if you are not gaining weight.

172. Food preparation. Although we have been given in this chapter a sound basis for planning our dietary, there are several reasons why a little knowledge of food preparation is of value to us.

Protective feeding means that a quart of whole milk and two raw leafy salads a day give sufficient minerals and vitamins to protect any sort of dietary if only the total quantity gives sufficient calories to furnish energy for growth and activity. Even if the food is poorly prepared, we cannot go far wrong if there is enough of it and if the protective foods are included.

There are times, however, when we wish to get all the good we can out of our food. Poorly prepared foods are very wasteful. They are usually also unpalatable. Although we need a great deal of indigestible food as roughage, this should be provided for in addition to the foods

needed for growth and energy, not from food that was meant to be digestible and is not. Poorly prepared foods tax the strength of the strongest digestive systems and are often actually injurious to the more delicate.

Mealtime in our homes means much more than just taking in so many calories, vitamins, and ounces of protein. Taste, like all other senses, is educable to fine discriminations, and there has grown up an art of food preparation that has real æsthetic value.

The artist does not use a great number of tubes of paints of different hues and tints, but makes many of these from a few fundamental colors. So the good cook needs only to know a few general facts about the essentials of food preparation to enjoy working out her own menus.

Some foods are difficult or slow to digest, and are hence to be avoided by growing boys and girls. Especially bad are fried foods, particularly fried starches; rich foods, that is, with sugar and fat in intimate mixture; raw starches; fresh pork and, some say also, veal. Concentrated sweets, particularly cane and beet sugars, are to be eaten sparingly. These high-calorie foods give excess of energy without the accompanying building foods, minerals, and vitamins needed in a well-balanced ration. Sweets should therefore always be eaten with a full meal of other foods.

Cereals. The purpose in cooking a cereal is to soften the cellulose cell walls and to swell and soften the starch granules so that the food is easily digested and also more palatable.

Cereals have a better flavor if cooked slowly for a long time. They are just as digestible if heated only long enough to cook the starch thoroughly, — fifteen minutes of hard boiling, or about thirty minutes in the double

boiler, — but the long, slow cooking is worth while because of the improvement in flavor.

Cereals contain very little water, so it is necessary to add large amounts in cooking. To one tablespoonful of finely ground cereal use six tablespoonfuls of water, and to one tablespoonful of flaked cereal use four tablespoonfuls of water.

In cooking a cereal, put the water in the top of a double boiler, add salt, and heat to boiling (over flame). Now slowly add the dry cereal. It is well to make a finely ground cereal into a paste with cold water before adding to the hot water. A ground cereal must be stirred constantly to prevent sticking. Do not stir a flaked cereal; simply shake the pan in order to prevent the flakes from lumping and sticking to the bottom. Boil the cereal directly over the flame for five or ten minutes; then place it over hot water in the double boiler and cook for at least half an hour. It may be cooked overnight in a fireless cooker.

Fruits. Fresh fruits are best eaten raw.

Dried fruits, such as dried apples, apricots, peaches, dates, figs, prunes, and raisins, are a very valuable item of our winter diet. The method of preparing these for the table has a great deal to do with food value and palatability.

To prepare dried fruit, wash, cover with water, and leave to soak overnight. Cook the fruit until tender in the same water in which it was soaked. Sugar may be added if the fruit is not sweet enough.

Cocoa. Cocoa is a delicious beverage and is nutritious if thoroughly cooked and not served too strong. If it is made as follows, the starch is thoroughly cooked and does not contain too much of a stimulating substance which closely resembles the caffeine of coffee.

Make a paste of one tablespoonful each of cocoa and sugar and half a cup of cold water. Boil it about ten minutes. Add two cups of hot milk and mix thoroughly with the paste. Beating with a Dover egg-beater improves it by forming a heavy froth on the top and preventing the formation of a scum.

Vegetables. Wash the vegetables, pare, and remove withered portions. Cut into pieces of the desired size or leave whole in the case of tiny carrots, onions, or small potatoes.

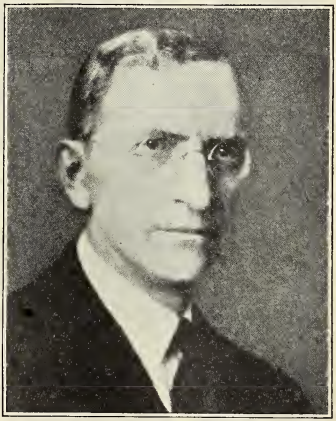
Use just enough water to finish the cooking. If a small amount of water is left, serve it with the vegetables or save it for use in soup or sauces. This conserves the valuable minerals which are dissolved out of the vegetables in the cooking water. Minerals are also conserved by cooking vegetables in their skins.

Eggs. The purpose in the cooking of eggs is to coagulate the protein into a palatable, jellylike mass. This can be done at temperatures below the boiling point. To prepare a soft-cooked egg, place it in a pint of boiling water, cover the pan, turn out the fire, and leave the egg in the water from six to ten minutes. When cooking several eggs use a pint of water for each egg. The white of the egg will be soft and jellylike.

Raw egg is digestible only if finely beaten. Raw eggs (sometimes swallowed whole by the advice of a physician) do not digest, because the white is so smooth and sticky that it slips through the stomach and small intestine too rapidly to be digested.

173. Planning a balanced ration. With the facts now at our command you are ready intelligently to plan your dietary. We know that we need approximately 70 per cent of carbohydrates (starch and sugar, with much cellulose

for roughage), 15 per cent of protein, and 15 per cent of fat. We know also that we need minerals and vitamins. We have learned that we need all the calories a healthy appetite demands if the food is well selected, well chewed, and partaken of under restful, cheerful conditions. Then, finally, a few specific things to avoid — concentrated sweets, fried foods, rich foods, raw starches, and hot, soggy breads—and a few essential things about food preparation.



DR. JOSEPH GOLDBERGER

Famous for his discovery that pellagra, found among people who live largely on fat pork, molasses, and white flour, can be prevented and cured by fresh proteins in the diet, particularly fresh meat and milk or fresh or dried yeast

On the basis of what we have learned you are now equipped to budget your own account of income and outgo of energy. Keep an accurate list of the food you eat every day, in calories, computed from the table in the Appendix. See that it meets the protein requirement and is protected by a quart of milk and two raw salads. Note whether four or more glasses of water are drunk. Enter each day also the number of hours of sleep in the twenty-four, — never less than ten. Enter also your hours of big-muscle activity, — four hours or more a day. No investment pays better than time and energy devoted to health.

174. Weight as a sign of growth. Weigh yourself periodically. If you do not gain, decide whether it is the sleep or the food that needs increasing. It may be both.

If you do not gain after a few weeks of this program of rest, food, and exercise, you should consult your physician. There is probably some correctible cause which can be very simply dealt with now but might be serious if allowed to go on. Of course your teeth, tonsils, and eyes are looked after as specified in Chapter X of this book. If you keep the record of your monthly weighings and also of your daily program of food, exercise, and rest, you will be surprised to find how easily your daily habits influence your growth.

The tables (pages 351–352) show the average weight for height and age of a large number of boys and girls who were well enough to be in school. You will be interested in seeing how your own weight compares with the weight of these boys and girls now, when you are not keeping the health essentials perfectly, and from now on, when you are living up to the whole health program, all the time, every day. If you keep it up, you will probably find that you are gaining over the averages of the tables.

A second exercise that will be profitable is to make out the food section of your own family budget. Include all members of the family. Give them plenty of calories, protein, minerals, and vitamins, with plenty of "scrubbing brush" roughage in the interest of internal cleanliness. Make your budget come to about 40 per cent of the total living expenses of your family, although family custom varies greatly as to food allowance; the smaller the income, the larger proportion of it, of course, has to go for food. The tables inserted here are based on cost of foods

and give sample menus for families of large, moderate, and small incomes.

The summer camping trip, or hike, has become an essential part of a vacation, whether the camp is in your own back yard or a thousand miles away from home. Keeping fit is a matter of balancing your exercise, rest (including sleep), and food. The more vigorously you are exercising, of course, the more food and sleep you need. A very practical exercise in connection with this chapter is to plan the rations for your trip. Your plan will vary, of course. Touring in an automobile, hiking, and bicycling require very different rations.

Camp cookery is discussed in so many books and magazines that a great deal of bad advice is given. A good lesson right here would consist of critically examining the directions given for rations at camp and on hikes in various scout and camp-fire manuals and in magazines.

The lives of men who have lived in the open furnish interesting suggestions.[1]

175. Cultivate good table manners. Good manners are a great asset in life. They are equal to money in the savings bank, because they make your presence acceptable to others, open many doors to you that would otherwise be closed, and give you a feeling of satisfaction in doing things in the right way. There is nothing that so discloses one's refinement as good table manners. One may be educated in science and the classics, but if he eats greedily at the table, shovels food into his mouth, and makes a loud noise as he gulps down his soup, he will soon be known as a boor. It is true that sometimes one may have a good

[1] John Muir's "The Story of My Boyhood and Youth," Houghton Mifflin Company, 1913; also Joseph Knowles's "Alone in the Wilderness," Small, Maynard & Co., Boston, 1913.

heart and have bad manners, but it is certainly a disadvantage to have manners that disguise one's beauties of soul. Probably one reason why we do not have better manners is because we do not know what to do.

Since good table manners ordinarily contribute to our ease and enjoyment in eating, they are valuable in promoting digestion. The following are helpful suggestions on table manners:[1]

I. USE OF SILVER

1. The knife is held in the right hand and is used for cutting, or for spreading butter. It is never to be used for carrying food to the mouth.

2. The fork is the most approved table implement. When in doubt what to use, choose the fork. After the food has been cut with the knife use your fork to carry it to the mouth.

3. Never cut more than one or two mouthfuls at a time. Do not cut up all your meat at once.

4. Fill your soup spoon with its point away from you, not toward you; then take soup from the side of the spoon, not the end. You can see, if you stop to think, how much less awkward it is to take soup from the side than to turn the whole spoon in so that you can take from the end. Never suck soup from the spoon.

5. Leave the spoon in the plate when you have finished; if the soup is served in bouillon cups with saucers, leave the spoon in the saucer.

6. When you are through eating, or if you pass your plate or cup and saucer for more food, leave your knife and fork parallel to each other on your plate, and your spoon on the dish where it belongs or on the saucer of the cup. Never leave the spoon in the cup. After using silver never leave it on the tablecloth.

7. Silver is arranged in the order in which you will use it — from the outside in; therefore use the outside spoon or fork first, and then, for the next course, the one next to it. When in doubt

[1] From E. E. Dodd's "Fiber and Finish." Ginn and Company.

as to what piece of silver to use, watch the person at the head of the table and imitate her.

8. Never use your own silver to help yourself from any dish that is for general serving.

II. DISHES

1. Do not drink from your saucer.

2. Never pick up a dish from the table to hold in your hand while you eat.

3. Do not push your plate back when you are through eating.

4. Do not stack your dishes. Leave them for your hostess to remove, or to have removed, in the way that suits her best.

III. THE NAPKIN

1. Let your napkin lie open on your lap. Napkins are not to be displayed needlessly, either by complete unfolding, by frequent use, or by conspicuous wearing or folding.

2. If food must be expelled from the mouth, as sometimes happens in the case of a small fruit stone, hold the napkin before the mouth while the food is removed with fork, spoon, or fingers and deposited on the plate. If possible remove the stone from the fruit before eating it, to avoid doing so after it is in the mouth.

3. The folding of napkins is the signal that the meal is over. Do not dispose of your napkin if you finish before others. This will call attention to the fact that they are still eating while you are not. Wait until your mother or the hostess folds her napkin; then dispose of yours, folding it and laying it beside your plate or putting it in the napkin ring if you are at home, leaving it unfolded beside your plate if you are a guest for a single meal.

IV. FOOD

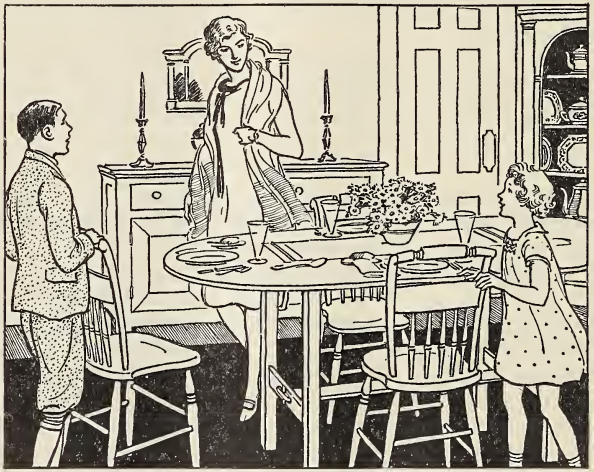
Certain kinds of food may raise a question as to the correct manner of eating them. Here are a few simple examples:

1. Break slices of bread, cake, etc. into four or five pieces, one at a time as needed. Do not carry a large piece of bread to the mouth and bite a piece out of it. Do not butter a whole slice, only a piece.

2. Eat corn on the cob, olives, small pickles, pieces of celery, radishes, salted nuts, bread, candy, and most cake from the fingers.

3. Eat sticky cake with a fork.

4. If open saltcellars are used instead of salt shakers, use the saltspoon or, if there is none, a clean spoon to convey salt to the plate. Radishes, broken celery stalks, etc. are then dipped in the salt; a fork is used to transfer it to other foods.



FINE TABLE MANNERS

Courtesy is one of the arts of happy and successful living

5. Raw fruits may be eaten in any way that is attractive and dainty, — sometimes carried to the mouth by the fingers, sometimes cut and served with fork or spoon. At a dinner one may be guided by one's hostess.

6. If you find a finger bowl provided at a luncheon, watch your hostess in the placing of it; then, at the time when she dips her fingers in it, dip the fingers of each hand in turn, drying them with the napkin on the knees.

7. Lettuce is usually cut with the fork, not with the knife; salad is eaten with a fork.

V. IF —

1. If an accident happens at table, make your apologies with the words, "I am very sorry," "Please excuse me," or some such phrase, help the hostess to remedy the disaster if that is possible, then dismiss the matter and try to forget it. Your embarrassment will break up the social spirit at the table if you allow it to be conspicuous.

2. If you have a cold and must sneeze or cough or clear your nose, do so as unobtrusively as possible, behind your napkin. If you continue to cough, ask to be excused from the table, returning when you are ready.

Try This

How well have you studied this chapter? Write the number of each exercise and choose the correct answer. Then go back over the chapter to make corrections.

1. The human body is composed chiefly of
   6 8 10 12 14 elements

2. For mineral substances we depend primarily on
   plants animals fowls

3. Nutrition may be thought of as
   the process of chewing food
   the supplying of the body with food
   the sum total of all the processes whereby food materials become a part of our living bodies
   the absorption of food into the circulation

4. Water is one of the essentials of the diet because
   it is wet
   chemical action would be impossible without it
   everybody likes water
   it is found in vegetables

5. We should drink at least
1 2 3 4 5 6 7 8 glasses of water daily

6. For building material we depend primarily on
protein water fats carbohydrates

7. Most people
eat too little meat
just about enough meat
too much meat

8. Cellulose is found chiefly in
meat milk vegetables water

9. The sugar which the body does not need immediately is stored in the
pancreas heart stomach intestines liver

10. Fat in the diet is most satisfying because it
builds muscle
takes longer to digest
takes less time to digest

11. The chief source of calcium in the diet is
milk rice meat vegetables spinach

12. Vitamins are necessary in our diet because they
contain many calories
directly build bones
are essential for the activity of the other elements of the dietary
contain many minerals

13. The vitamin which protects us against scurvy is
A B C D

14. The vitamin which takes the place of direct sunlight is
A B C D

15. The vitamin that occurs in abundance in dairy products is
A B C D

16. The vitamin found particularly in green leaves is

A B C D

17. A calorie is a measurement of

food weight
fuel value
the amount of water food contains
the amount of vitamins food contains

18. To have protective feeding we need to eat plenty of

muscle meat	white flour	milk and salads
griddle cakes	doughnuts	apple sauce

Interesting Things to Do

1. Keep a record of what you eat for a week. Report on whether you have a balanced ration.

2. Try a test on other members of the class. Make out a list of food for three different school lunches. Rate one excellent, one fairly good, and the other poor. Ask your classmates to identify each one.

CHAPTER XIV

THE MARVELS OF THE DUCTLESS GLANDS

176. Remarkable discoveries. Since very early times physiologists have known about the existence of many of the glands and also something about their work. As they went on with their study they found glands that seemed to be quite different from the better-known glands, since they were without ducts or pipes to carry their secretions away. It was finally discovered that their secretions soaked through the glands into the blood stream. At first their function was unknown, but finally it was found that some of them were of the greatest importance in keeping the body and mind in a healthy condition. Growth and mental development depend to a very large extent upon their work. If they are incapable of doing their work, idiocy, nervousness, overdevelopment or underdevelopment, and other disorders of growth may result. Many of the side-show freaks — the giant, the dwarf, and the fat lady — are victims of an unfortunate condition of the glands of internal secretion.

177. What is a gland? A gland is an organ that takes certain substances from the blood (which flows through the capillaries passing through the gland), and makes them into new substances for use in the body or for excretion from the body. A number of these glandular products have been discussed, such as saliva, gastric juice, bile, pancreatic juice, urine, sweat, tears, and mucus. These substances leave the gland through tubes or ducts.

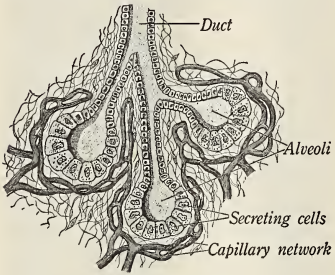
178. The ductless glands. There are other glands in the body — a whole system of them — which also take substances from the capillaries passing through them, but they give back the new substance which they manufacture into the same capillaries. The amount of the substances manufactured is very, very small, but they are very, very powerful. It is only within twenty or twenty-five years that the laboratories developed methods whereby these processes could be discovered and studied. There still remains a great deal to be discovered, but what is known has revolutionized our ideas about the growth and activity of all animal organisms and is revolutionizing medical practice in the case of a good many diseases.

WHY DON'T YOU GROW?

Difference in the secretions of glands, not in food, made one a giant and the other almost a dwarf

The glands of this system are called glands of internal secretion, or ductless glands, because their secretions are simply filtered back into the capillaries and are never collected in a vesicle or tube as is the case with the larger gland secretions mentioned above. They

are also called endocrine glands, or the endocrine system, from two Greek words meaning "to separate within." The secretions from these glands are most commonly called hormones, from a word meaning "to arouse to action." These secretions are also frequently called chemical messengers. From these numerous terms we get the impression of something small but powerful. Indeed, all the glands of internal secretion in a human body could be placed in a child's ordinary pencil box and carried in one's pocket. The removal of any one of at least six of these, however, would cause death, so essential are they to the operating efficiency of the body.

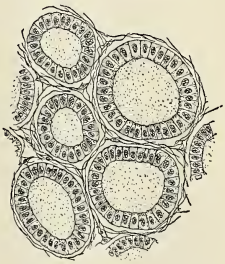


A DUCT GLAND

The cells secrete into the sacs or alveoli; the secretion then passes out through the duct

179. The thyroid. The best-known and first to be studied of these endocrines is the thyroid. This is a two-lobed gland which sits astride and in front of the windpipe (see page 224). Enlargement of this gland is called goiter. A person with an enlarged thyroid is too active in mind and body. He expends too much energy. On the other hand, a deficiency of the thyroid is shown in sluggish activity or a lack of growth. The principal job of the thyroid seems to be that of stimulating the cells to take up iodine from food and water, and the internal secretion of the thyroid makes this available to or usable by the tissue cells, and regulates the amount taken into the blood stream.

The iodine-controlling hormone, thyroxin, is sometimes called the vital antiseptic of the body. This hormone stimulates growth and also the oxidization or energy production. It especially stimulates the development of the brain. The thyroid functions before the child is born. If it is inactive to any marked degree, the child may be born an idiot. Normally all water and all vegetation contain iodine obtained from the soil. This iodine was left behind as part of the salt deposit when the sea receded from the hills and plains. In certain regions the rains and rivers have drained away too much of this, and the people and animals do not get enough iodine in their water and food. Under such conditions goiter develops, because nature tries, by enlarging the gland, to protect the body from this deficiency. Giving minute doses of some form of iodine, preferably in the form of thyroxin, will prevent or cure mild cases of goiter. In some of the goiter regions all school children are given some form of iodine in order that the growth of the body and the activity of the brain may not be impaired.

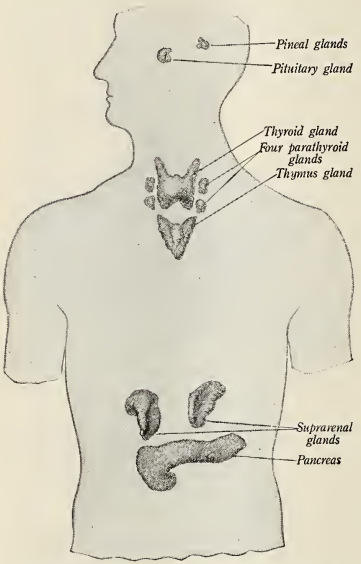


A DUCTLESS GLAND

This is a section of part of the thyroid gland. The cells secrete into the closed sacs which they surround. The internal secretion then seeps out between the cells into the lymph

180. The thymus. Behind the breastbone another endocrine gland is found, — the thymus. This secretes a hormone which acts as a brake, or check, upon the thyroid and other stimulating glands and keeps the child from growing up faster than the organs and parts of his body can be finished properly, or "seasoned." This is the gland

which prolongs childhood. The human animal has the most helpless infancy and the longest childhood of all the young things in creation. He is the most complex living thing in creation after he is finished. Nature must have time to accomplish this, and the tremendous vital forces which make the child grow must themselves be regulated.



SKETCH SHOWING THE LOCATION OF GLANDS OF INTERNAL SECRETION

Consult this as you read about each of these glands

After the individual has got his growth the thymus atrophies or becomes smaller and has little known use in the body.

181. The pineal. This is another regulating or retarding gland, a very tiny affair about the size of a small grain of corn. It is located near the center of the brain. If this is removed or injured in a young child, he seems to speed up his growth and run through his life cycle explosively. Such a child may show the body and mind of twelve or fifteen years when he is only three or five. Such children usually live but a few months or years. Find this gland in the illustration above.

182. The pituitary. This endocrine gland is about the size of a small cherry. It is found back of the nose above the roof of the mouth. It is so important that nature made a special pocket for it in the floor of the skull. This is called, from its peculiar shape, the sella turcica, or Turkish saddle.

Small as it is, it has two parts which produce very different secretions. The anterior hormone stimulates the growth of bone and connective tissue. If the anterior lobe is too large, it may produce giants with enormous faces, hands, and feet; if it is too small or diseased, the person may be a dwarf.

The posterior hormone stimulates rhythmic contraction of involuntary muscles. Oversecretion raises blood pressure and causes increased intestinal peristalsis. Pituitrin, the hormone from the posterior lobe, has been extracted from the pituitaries of sheep and is used in medicine to relieve shock and extreme depression, such as occur after operation or hemorrhage.

Pituitrin also helps maintain the salt ratio of the body, and thus helps the thyroid in preserving a condition of our body necessary for its proper working.

The pituitary gland may have something to do with producing sleep, including the winter sleep of hibernating animals; at least it is said to atrophy during the hibernating period.

Too little pituitary secretion makes one sluggish and fat. Certain types of very round-bodied, fat, but small-boned persons are thought to be cases of pituitary insufficiency. The body is not stimulated to burn up its fat fuel.

Persons with very active pituitaries are the "thin eaters," who have great energy and great endurance but

who cannot be fattened up. These people burn up their body fuel every day.

The pituitary and the thyroid are the great energy regulators of the body; the thyroid speeds up energy production, and the pituitary, energy expenditure.

183. The adrenals. The adrenals are known as the glands of "emergency energy." They are two fatty, yellow, crescent-shaped glands lying over the top of the kidneys. The adrenal consists of a central core, the medulla, and an outer layer called the cortex or bark. In the embryo the adrenal cortex is larger than the kidney and is active in helping the thyroid direct the development of the child, especially the brain development. If it is small or lacking, the brain fails to develop. This cortex seems to have something to do with the distribution of pigment in the skin, thus regulating the sensitiveness of the skin to light. Also, it may be called the "fight-producing organ," as it is large in pugnacious, or fighting, animals and small in timid animals like the rabbit. The human being has a relatively large adrenal cortex.

The adrenal medulla, or core, produces the now well-known internal secretion called adrenalin. The blood contains normally about one part in twenty million. The cores contain one hundred thousand times this amount, stored as reserve. Under nervous stimulus, such as rage or fear, this reserve is fed into the blood stream, whereupon the liver is stimulated to release glycogen, or liver sugar, into the blood stream. This provides quick fuel to the muscles. The liver is the official fireman, who keeps an even heat by keeping just so much sugar fuel in the body tissues. The adrenals run the thermostat. In an emergency the thermostat throws the dampers wide open, the fireman throws on a lot of kindling,

and the steam gauge climbs up with incredible speed. The bulk of the blood goes to muscles and brain; sight and hearing are quickened. The animal can then put forth exertions in fight or flight which would ordinarily be quite impossible. It is under such conditions that invalids get out of burning houses, and dogs fight in a death clinch such that they seem insensible to pain and cannot be pulled apart.

Adrenalin is used in medicine very much as is pituitrin, to stop hemorrhage and raise blood pressure in cases of shock or collapse. Too little adrenalin in the normal blood stream occurs in chronic neurasthenia. It is associated with the tendency to worry and weep.

184. The parathyroids. These are four tiny glands, about the size of grains of wheat, lying upon the lobes of the thyroid. They regulate lime metabolism, binding the lime to bone and blood. If they are injured or removed, the bones soften, the hair drops out, and the animal becomes excessively nervous, cannot sleep, and soon dies.

185. The pancreas. The pancreas proper, also known in the animal as sweetbread or abdominal brain, lies back of the stomach and secretes digestive fluids which are poured through the pancreatic ducts into the intestine. Scattered through the pancreas, however, are minute patches of gland cells called islands of Langerhans, which secrete the now well-known internal secretion, insulin. This seems to regulate sugar metabolism by acting as a check upon the liver in its release of sugar to the blood when it is overstimulated by the adrenals. Berman says that the adrenals and the pancreas are the two pans of the scale regulating sugar metabolism. When the islands of Langerhans do not function, too much sugar is released, and urine and blood become saturated

with sugar, producing the disease known as diabetes. Medical science has not succeeded in restoring these glands to activity when diseased or destroyed, but insulin is now used to replace these secretions. It is a remedy, but not a cure, for diabetes, as the patient must go on taking it just as he takes food. After diet and dosage are adjusted to his condition, he may thereafter experience quite normal health.

186. Secretin. Secretin is the messenger that keeps the pancreas informed as to the amount of digestive fluid needed for the food coming into the intestines from the stomach.

The gastric juice, we have learned, is acid, from the hydrochloric acid contained in it. The partially digested food, when ready to be discharged from the stomach into the intestine, is acid. As soon as any of this acid mixture leaves the stomach, it causes the formation, in some of the cells of the intestine, of a hormone called secretin, which travels in the blood to the pancreas and stimulates the secretion of pancreatic juice. If only a little food is ready, the alkaline pancreatic juice and bile soon neutralize it and the flow stops. If more food is to be digested, it contains more acid and takes more pancreatic juice to digest it. This chemical messenger, secretin, being formed as long as acid is present, thus keeps the distant pancreas informed as to exactly the amount of digestive fluid to secrete.

187. Summary. The best-known endocrine glands have been mentioned. There are others which are not so easily studied as even these. Enough has been said to show that the one part in millions of thyroxin and adrenalin is as important to the life and health of the body as are the carbohydrates, fats, and building foods, which the hormones enable us to make use of.

These chemical messengers are like the workmen who put the lumber and screws and brick and mortar together to form a house. These might be assembled in neat and orderly and sufficient piles forever if men, working by plans and under the constant direction of overseers, did not combine them in proper sequence and proportion.

In a way the thymus gland, the pineal gland, and the islands of Langerhans might be called timekeepers which tell the glands of the body when to stop. The thyroid gland, the pituitary gland, and the adrenals are overseers bent on getting all the work possible out of their workmen in the various factories and laboratories of the body. Like a good many bosses, they would work their men to death if they were not restrained by official timekeepers working under rules and directions from the real head of the particular industry involved.

You know that the timer is an important part of the automobile engine. Engine, factory, and the human body all go on strike if the activity and relationship of their parts are not carefully and smoothly adjusted.

Many interesting and important things are certainly going to be discovered in the near future in the many research laboratories that are now working in the field of ductless glands. Everyone should watch for the announcements of these as they appear.

188. The hygiene of the ductless glands. The glandular system is well built and thoroughly tested before birth if the mother has eaten what she should and taken good care of herself. It is like a watch sent out from a good factory; it will run for a natural lifetime if oiled and cleaned regularly.

The endocrine system can be thrown out of balance by lack of lime, salt, or iodine, by eating too much sweet,

by long-continued nerve strain, by too little sleep, or by any other serious violation of the rules of health. It runs noiselessly and does not make us aware of having glands, except through a sense of vigor and joyous well-being, as long as we give the engine the proper kinds of fuel and care.

Can you match These?

1. A ductless gland	is the name given to all the ductless glands
2. A duct gland	makes one sluggish and fat if insufficient
3. The thyroid	helps to regulate growth
4. A hormone	pours secretions into the blood
5. The thymus	is located near the center of the brain
6. The pineal	— the tear gland is a good example
7. The pituitary	cause sleeplessness if injured
8. The adrenals	depends on iodine in food and water for its healthy condition
9. The parathyroids	cause diabetes if they do not work
10. Secretin	is a messenger to the pancreas
11. Islands of Langerhans	is a chemical messenger
12. The endocrine system	manufacture substances which increase muscular strength

Interesting Things to Do

1. Collect some pictures of freaks and write a composition on how their condition might have been caused by disorders of the ductless glands.

2. Prepare a three-minute talk on the importance and care of the ductless glands.

CHAPTER XV

GOOD APPEARANCE, HEALTH, AND POSTURE

189. Watching the crowd go by. It is interesting to stand on a street corner and take time to watch a crowd go by. How different every person is from every other person. They are stout, thin, tall, short, dark, fair, neat, unkempt, happy, sad, healthy, crippled, and so on. Each person is individual. As you watch the busy throng go by, you will notice that some of them seem much more attractive than others. It may be because of dress, facial expression, or charm of manner.

One of the striking things that you will notice is the way people walk. How ugly some of them look! There is a high-school boy with a shambling gait. Here is a middle-aged woman who waddles like a duck. Notice that high-school girl who is approaching. How thin she is! Her shoulder blades protrude, she is stooped, her chest is flat, and her head sags forward. When she looks up, you notice that she is pale. She has striking eyes and beautiful hair. Her smile is pleasing. Soon she is lost in the crowd, and you find yourself feeling sorry for her because she does not stand and walk correctly. If she had only mastered that art she would be an unusual-looking young woman. It may not be due to bad habits but to physical defects or malnutrition.

Ah, who is this coming? He may be an old man, for his hair is white and he uses a cane; but he carries himself better than most young men. It is Mr. Stoddard, a veteran of the Civil War. How tall, erect, and commanding

he looks. You feel that you are in the presence of an extraordinary personality. He is the hero of a hundred fights and a splendid citizen — and he looks it.

How unusual it is to see somebody who has a distinctive carriage! How bent and crooked nearly all of them, young

AN INTERESTING CROWD

How many have good posture? Study a real crowd. How many persons in ten have good posture?

and old, seem to be! There is somebody who is quite different. It is a college senior. He is well dressed, but that is not the most distinctive thing about him. Not only does he have good color and a splendid physique, but his abdomen is held well back, his chest is held forward, and his neck is erect and straight. He impresses you as one who is meeting with success and is destined to continue to

be successful. If you were the head of an educational or business establishment, and he applied for a position, you would feel favorably disposed toward him.

Perhaps you go home wondering whether you have a carriage that spells distinction and impresses other people with your personality. Probably you will stand before a long mirror as you naturally stand, and study your figure. If the examination is disappointing, you may comfort yourself with the fact that you can train yourself to have a better figure. It was Elbert Hubbard who said:

> Keep your mind on the great and splendid thing you would like to do, and you will find yourself unconsciously seizing upon the opportunities that are required for the fulfillment of your desire.
>
> All things come through desire, and every sincere prayer is answered.
>
> Carry your chin in, and the crown of your head high. We are gods in the chrysalis.

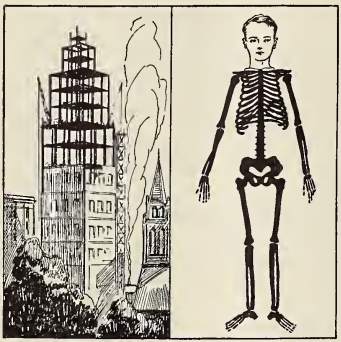
Then let us hope that this story ends, as all good stories end, with your setting out to improve your posture, and that you improve so fast that you surprise your friends and parents. The pages that follow will tell you how to do it.

190. Use of the bones. The shape which the body takes has much to do with appearance and good health. The bones help to give the body shape and to protect the delicate organs. Children who have rickets, for example, are likely to be bow-legged. There is a lack of mineral matter in the bones. They lack hardness, and so they bend. It would be impossible for us to have shapely and efficient arms if there were no bones. The whole body would be largely a shapeless and useless mass.

Many of the principal organs of the body are ingeniously protected by the bones. The delicate and important

brain is inclosed in and protected by the skull, a wonderful chamber made of bones. The ear and eye are also well protected. The heart, lungs, and digestive organs are fairly well surrounded by bones.

A third function of the bones is to serve as levers for the attachment of the muscles and tendons. Without the bones we should not be able to stand or to walk.



A GOOD FRAMEWORK IS NECESSARY FOR STRENGTH AND BEAUTY

191. The joints. Our movements are dependent also on the way the bones are joined together. These meeting places are known as joints. Some of the joints are immovable, like those in the skull, but the vast majority of them are movable. The principal kinds of joints are the ball-and-socket joint, the hinge joint, and the gliding joint. An example of the ball-and-socket joint is at the shoulder. There the large bone of the arm is rounded out in the shape of a ball at the end, and fits into another bone which is hollowed out into a cup, or socket. The ends of the bones are covered with delicate membranes and lubricated. This kind of joint permits the free movement of the arm in many directions. The hinge joint, as the name implies, permits movements in two directions only. The joints at the elbow and in the fingers are of this kind. Good examples of the gliding joints are found at the wrist and in the spinal column.

192. Work of the muscles. The muscles may be attached directly to the bones. Usually they are fastened to stout cords called tendons, which are attached to the bones. Since the tendons require a much smaller space than the muscles, they are less bungling. For example, if muscles instead of tendons ran down to the fingers, the hand would be unwieldy.

The muscles are arranged in pairs. When one of the pair contracts, the other relaxes. In keeping ourselves erect and in proper balance the muscles work somewhat like a teeter board. The ends of the teeter board move in opposite directions. For example, when you let your head sink down, notice how the muscles under your chin shorten and grow thick. As you throw your head back, notice how these same muscles are stretched and become thinner. What is happening meanwhile to the muscles of the back of the neck?

Thus we see that to assume good posture we need to have a proper balance of the muscles. Stooping shoulders are due to the lack of tone or strength in the muscles of the upper part of the back. They have become too relaxed and elongated. The muscles of the breast, on the contrary, have become too short. The person with erect posture has perfect balance of the muscles.

193. Results of bad posture. One of the important results of a bad posture is ugliness of appearance. The boy or girl, man or woman, who stands, sits, and walks keeping the body erect looks young and commanding, and impresses you with a sense of personal power.

194. Bad habits the enemies of good posture. One of the chief causes of bad posture is the neglect to use the body in the right way. Many boys and girls get into bad habits. After these are formed, they have difficulty in

breaking them. Often this requires more than will power. They may need exercises to strengthen certain muscles and restore the bodily balance. Let us now consider some definite suggestions on the proper use of the body.

195. Correct standing position. The body is in a good condition mechanically when it is erect. In such a position the weight is distributed evenly on the two feet. The chest is elevated and is the part of the body farthest forward. The abdomen is in, or flat. The back curves are not exaggerated. By comparing the illustrations on pages 237 and 239 it is easy to see that correct posture must necessarily give the organs of the body a better chance to work. Is there any doubt that the person who maintains good posture is better able to do a strenuous day's work?

To understand what a good standing position is, study the positions on page 237. Study your figure in a long mirror. Should you rate yourself as *A*, *B*, *C*, or *D*?

It is sometimes said that clothes make the man, but is it not better to say that good posture enables one to show off his clothes to advantage? The man who is poorly clad excites a certain amount of favorable attention if he has an erect posture. The boy with stooped posture, after a course in military training, often emerges as a different-appearing person.

Bad posture interferes with the working of the vital organs. Our health and vigor are dependent on the action of the heart, lungs, digestive system, and other vital organs. If they do not have enough room and are displaced, they cannot perform their work, and ill health and disease may result.

Bad posture, since it interferes with the proper working of the body, increases the general fatigue. One cannot

A

EXCELLENT POSTURE

1. Head up and chin in (head balanced above shoulders, hips, and ankles)
2. Chest up (this part of body farthest forward)
3. Lower abdomen in (and flat)
4. Back curves within normal limits

B

GOOD POSTURE

1. Head slightly forward
2. Chest slightly lowered
3. Lower abdomen in (but not flat)
4. Back curves slightly increased

C

POOR POSTURE

1. Head forward
2. Chest flat
3. Abdomen relaxed (this part of body farthest forward)
4. Back curves exaggerated

D

BAD POSTURE

1. Head markedly forward
2. Chest depressed (sunken)
3. Abdomen completely relaxed and protuberant
4. Back curves extremely exaggerated

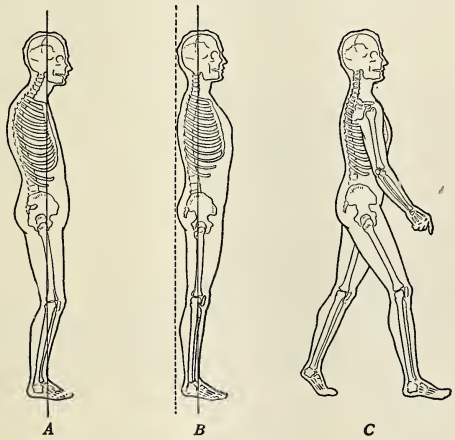
ARE YOU *A*, *B*, *C*, OR *D*?

perform his work easily unless he knows how to use his body. If you set a block up on end, you will notice that it stands without difficulty. If it is tilted forward, it is in unstable equilibrium. Human beings in such a situation strain themselves to keep their balance. Often they throw their stomachs forward and their shoulders back, making a decided hollow in the back. Such a position markedly increases fatigue. The posture just referred to is common when one wears high-heeled shoes.

196. Good health promotes good posture. The bones and the muscles depend for their strength on the general health of the body. Sleep, sunshine, nutritious food, recreation, freedom from disease, and all the health habits contribute to the health of the bones and muscles. If the muscles are not properly nourished, they lose their tone and become flabby, and the body tends to droop. Some people, because of habitual fatigue and general ill health, do not have enough strength to stand, sit, and walk in good posture.

197. Correct walking position. Walking is similar to standing except that there is movement. Running and the positions taken in athletic activities are merely modifications of the general position of walking. In walking the trunk should be kept erect. A common fault in walking is to turn the toes out. For the protection of the arches and for general ease in walking the toes should point straight ahead. The legs should swing freely; the heel should strike the ground first, but the weight should be quickly transferred from the heel to the ball of the foot, so that there may be a good push-off from the toes in the next step. Most people carry the weight of the body too far in the rear. It is much less fatiguing to carry the weight forward, so that all parts of the body are in a

straight line. Let the arms swing easily but with no exaggerated motion. The posture in walking should enable one to move the body forward gracefully and with the least effort. Running should be on the balls of the feet



BUILDING GOOD POSTURE

Try this exercise if you need it: suppose that you have very poor posture (*A*); by placing your head, shoulders, and hips against the wall, put yourself in good posture (*B*); try to hold this position and walk off (*C*)

and not with the foot flat. Running with a light step helps to strengthen the leg muscles that keep the body in an upright position.

198. Correct sitting position. Since most of us spend many of the twenty-four hours in a sitting posture, the kind of chairs we sit in and the positions we assume are exceedingly important. Unfortunately much of our school furniture is not suitable for use or is improperly adjusted. In general the sitting position should be such that the

muscles not in use are relaxed and the person is comfortable. A chair that is too high or too low, or too close to a table or desk or too far away, encourages bad posture. The chair should be of such a height that the feet rest comfortably on the floor, the knees not being elevated much above the level of the chair seat. In bending forward to work, care should be taken to lean forward from the hips with the spine kept straight.

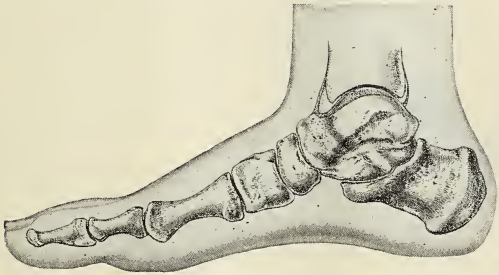
A CORRECT SITTING POSITION[1]
Can you tell why?

199. Fashion and shoes. What crimes against good health are committed in the name of fashion! The vast majority of the people, especially young people, who buy shoes ask the question, What is the latest style out? Then they proceed to buy the pattern presented, regardless of looks, comfort, or health. The idea is not to fit the shoe to the foot, but to force the foot to conform to the shoe. It is true that the salesman sometimes gives good advice, but usually he knows little or nothing about the hygiene of the feet, and simply wishes to make a sale. Under such conditions it is not strange that the majority of people have foot troubles. About 85 per cent of the men drafted into the American army during the World War had some kind of trouble

[1] From Bennett's "School Posture and Seating," p. 93.

with their feet. There are two important reasons for trouble with the feet: ignorance of the importance of the feet in maintaining good health, and unwillingness to take proper care of them.

200. The foot a marvelous mechanism. The foot is one of the wonders of the human body. It must be strong enough to bear the weight of the body and yet flexible enough to bend with ease in walking, jumping, and running. These



THE BONES OF THE FOOT

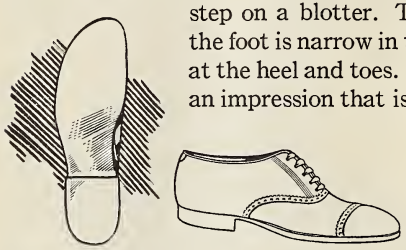
Notice the longitudinal arch

two needs are supplied ingeniously by the human foot. It has twenty-six bones bound together by many ligaments and controlled by muscles and nerves. These bones are arranged to form arches. The two principal arches are the longitudinal arch, extending from the heel to the great toe, and the transverse arch, extending across the ball of the foot. The arches are maintained by ligaments in much the same way as a bow is bent by a bowstring.

When the foot is misused by putting too much strain upon it or by wearing ill-fitting shoes, the arches may begin to sag and the bones slip out of place. Distress is bound to follow. Not only is there likely to be pain in the

foot itself, but such a disorder may cause backache, headache, continued fatigue, poor circulation, indigestion, and other serious disorders.

The most common type of foot ailment is flatfoot, or fallen arch. It is caused by a flattening of the long arch, which extends from the heel to the great toe. To determine whether you have a tendency toward flatfoot, moisten the bottom of your feet, shake off the excess, and step on a blotter. The normal print of the foot is narrow in the middle and wide at the heel and toes. The flat foot leaves an impression that is about the same for its entire length.



WEAR A SHOE LIKE THIS FOR COMFORT, GOOD POSTURE, AND HEALTH

201. Suggestions on buying shoes. The first essential in selecting shoes is to *buy a shoe that fits properly.* Many people ruin their feet by buying shoes simply because they are cheap. They trust that after they are "broken in" they will be all right. The proper kind of shoe should be comfortable from the beginning. Do not buy the shoe that needs breaking in.

Take plenty of time when you buy shoes, so as to get a good fit. It will pay to use brains in buying shoes. Some retail stores have adopted the plan of encouraging the customer to look at his feet through an X-ray machine which they furnish.

A good shoe may be described as follows: It corresponds to the natural shape of the foot. The inner line from the heel to the great toe should be approximately

straight. The end of the shoe should not be so rounded or pointed as to restrict or press against the toes. Such a shoe is responsible for bunions, corns, and other troubles. The sole should be flexible. The thickness depends on the kind of service demanded. For comfort in walking on pavements a fairly thick sole is necessary. The heel needs to be as broad as the heel of the foot and comparatively low. High heels are responsible for much bad posture. A person who wears high-heeled shoes is able to keep his balance only by throwing out the stomach and hollowing in the back. Such a shoe also brings unnatural pressure on the arch and crowds the toes. Rubber heels are desirable because they absorb shock. The leather of a shoe should be flexible and pervious to the air. Patent leather, rubber, and similar materials may be useful to keep out water, but they should not be worn continually.

WEAR THIS AND WALK INTO TROUBLE

202. Care of the feet. Common troubles with the feet are corns, blisters, and ingrowing toenails. Generally they indicate that ill-fitting shoes have been worn. While treatment will relieve the difficulty, the change to well-fitting shoes is necessary for cure and prevention. Blisters are dangerous because of the possibility of infection. The most careful precautions in regard to cleanliness should be observed. A broken blister should be dressed with aseptic dressings, preferably by a physician.

Special attention should be given to the bathing of the feet. After athletic games, hikes, or hard physical work the feet should be bathed. A hot bath is better than a cold one for the removal of deposits of perspiration and dirt. The hot bath should be followed by one in tepid or cold

water, to toughen the skin and protect the feet against the rubbing of the shoes. Stockings should be changed every day.

Choose the Best Ending

Notice that there are three ways of ending each sentence. Select the ending which is best.

1. Good posture is (entirely the result of eating the right kind of food) (usually a sign of health) (always the result of good habits).

2. Strong, healthy bones are desirable because they (are better able to support the body) (require less lime) (are a part of the body).

3. A joint is a point where (two muscles come in contact with each other) (a muscle and tendon are united) (two bones come in contact with each other).

4. The chief work of the muscles is (to connect with the bones) (to enable the different parts of the body to move) (to make the body beautiful).

5. We should form good habits of posture because good posture (always enables us to breathe better) (helps to keep our feet in better condition) (promotes the general health of the body).

6. To form good habits of posture (stay up at night frequently) (avoid the drinking of milk) (try every day to sit and stand in the proper way).

7. The chief physiological value of good posture is that it (gives the vital organs a better chance to work) (hardens the bones) (improves the personal appearance).

8. To walk correctly be sure (to have the toes pointing straight ahead) (to have toes in and heels out) (to wear high-heeled shoes).

9. In the best sitting position (the feet should not touch the floor) (the back of the chair should not be adapted to the shape of the back) (the feet should rest comfortably on the floor).

10. When you buy shoes (remember the qualities of a good shoe) (rely entirely on the advice of the salesman) (buy a shoe that is a little tight, so you can break it in).

Interesting Things to Do

1. With the help of your hygiene teacher or instructor in physical education try to find out whether your posture is graded *A*, *B*, *C*, or *D*. If you are not an *A*, get suggestions as to how you can improve your posture. Give yourself daily training.

2. Make a collection of shoes of all kinds. Let a committee from the class, one of whom should be your teacher, arrange the shoes in order according to their worth as healthful shoes. Let all the other members of the class take the test of arranging them in order.

CHAPTER XVI

BEAUTIFUL SKIN AND HAIR REFLECT HEALTH

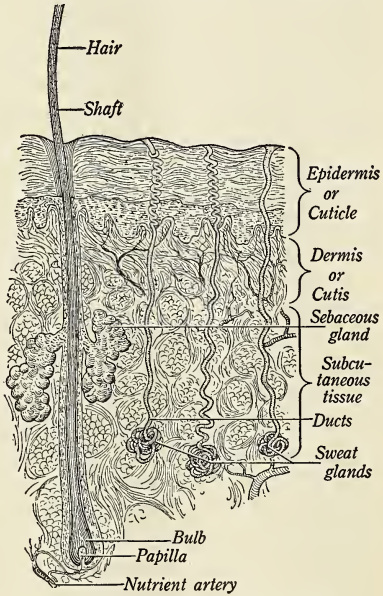
203. The natural desire to be good-looking. Good looks, like gold and precious stones, have always lured men and women to undertake remarkable adventures and do most unusual things. At the very dawn of history we find that women had vanity cases and that both men and women resorted to tattooing and fanciful dress to attract attention. Among savage tribes even facial disfigurement, like slitting the ears, and blackening the teeth by chewing the betel nut have been among the curious and mistaken methods of attempting to add to personal charm.

While there are many things that contribute to good looks, everybody will agree that one's physical attractiveness is largely dependent upon the appearance of the skin and hair. The regularity of the features of the face is important, but a Venus with a sallow, blotched, pimply face would not be a Venus. An irregular face with a good clear skin crowned by a luxuriant growth of glossy hair immediately impresses one with its attractiveness, not to say beauty. This is true of boys and men as well as of girls and women, although the former are a little more reluctant about admitting it.

The purpose of this chapter is to indicate how the hair and skin may be properly cared for. Let us first consider the skin.

204. Structure of the skin. The skin is a tough, flexible membrane which protects the tender flesh underneath.

The outer layer, the epidermis, is especially tough, dry, and hard in exposed places like the palm of the hand and the bottom of the foot. It is without blood vessels and nerves and is united to the dermis, or true skin, underneath by an adhesive-like substance. The lower layers of the epidermis are composed of living cells that are nourished by lymph (see page 153), which flows through canal-like spaces between the cells. These are very soft and spongy, and are continually dividing and growing. As they migrate upward farther and farther from the seat of nourishment they get drier and harder, and die, but remain good protectors. As they become worn off they are continually replaced by the growing cells underneath. The pigment that chiefly distinguishes the black or red man from the white man is found in the epidermis.



DIAGRAMMATIC DRAWING OF SKIN AND HAIR

Study this as you read the text

Beneath the epidermis is the dermis, or true skin. Instead of horny cells it is made up of fibrous tissue. It is

the most important part of the skin. The dermis is supplied with blood vessels, nerves, lymph vessels, muscles, hairs, oil (sebaceous) glands, and sweat glands. The elasticity of the skin depends mainly on the elastic fibers of the true skin. If they are numerous and healthy, the skin is likely to be smooth and to have tone.

Underneath the dermis is the subcutaneous tissue, which serves as a kind of pad or cushion for the nerves and blood vessels, protecting them against outer pressure and injury.

205. Work of the skin. Many people think of the skin as something almost apart from the rest of the body, simply as a kind of casing. It is really an organ as much as the heart and lungs, and has several functions.

The first of these is its protective function. The horny layer of the epidermis offers protection against mechanical injury and against the absorption of dangerous substances, such as acids and caustics. It prevents the too rapid evaporation of water from the body. As long as the skin is intact it also protects against infection. Even the scratch of a pin may, by breaking the skin, lead to serious consequences. The presence of oil in the skin, supplied by the oil glands, makes the skin largely waterproof. The pigment, or coloring matter, of the epidermis screens out the harmful rays which might injure the deeper tissues. The coat of tan protects the skin against the sun's rays. The hair and the nails, which are really modifications or parts of the skin, also protect against extremes of temperature and against mechanical injury.

The skin is sensitive. It contains many tiny sense organs and nerve endings. The sensations of warmth, cold, pain, and pressure originate in the skin. They give us many valuable messages about the world with which we come in contact.

The skin helps to preserve the constant temperature of the body. When the body becomes overheated, an increased supply of blood is sent to the skin, the sweat glands are stimulated to pour out their secretions, and evaporation cools the skin. When the body is in danger of losing too much heat, the blood supply to the skin is lessened and the sweat glands cease to function noticeably.

Some excretion of wastes takes place through the skin. This was very much overemphasized by earlier writers on hygiene. The sebum, or oil manufactured by the oil glands, and the perspiration are largely secretions rather than excretions. The skin does throw off a small amount of poisonous wastes, but most of these are disposed of by the kidneys and intestines.

The skin breathes in a way similar to that of the lungs, but this activity is slight.

One of the peculiar properties of the skin is its power of renewing itself, or at least of forming a protective scar tissue. If some of it is lost by a scratch or burn, it has the power of growing and becoming as good as ever.

206. General good health affects the skin. It is important to remember that the skin is a part of the body, and anything that affects the general health of the body is likely to affect the health and appearance of the skin. The skin depends upon the blood for its nourishment. The skin feeds upon blood and only upon blood. It is therefore ignorance and ignorance alone which impels so many thousands of people each year to buy drug-store preparations known as "skin food."

The face may not be the mirror of the soul, but it is to a remarkable extent the mirror of the body. As Dr. Levin says, "Complexions are dials on which the body's health is recorded." Although there are occasionally external

conditions affecting the skin, the majority of its disorders result from unfavorable bodily conditions. Lack of sufficient hours of sleep, poor elimination of wastes, improper food, overindulgence in sweets, fried foods, or delicatessen foods, lack of rest and exercise, — all these bad habits, if persisted in, are certain eventually to injure the complexion and the skin. All athletes know how well the general health is reflected in the skin. The boxer is not physically fit until he is in the "pink of condition," — until the skin shows the glow of health.

207. Pimples and blackheads. One of the most perplexing problems of youth is to keep the face clear from pimples and blackheads. They are among the most common reasons for a poor complexion. The direct cause of this malady is the overworking of the fat glands of the skin. This is invariably accompanied by an excess of the top, or horny, layers of the skin. These horny cells of the skin multiply so fast that they prevent the natural drainage of oil from the fat cells. The blackhead shows on the skin as a black dot. This is either dirt or an accumulation of old dead cells. If blackheads are allowed to remain, they may become pimples. Often they become enlarged and inflamed. Possibly through scratching they may receive a secondary infection and pus may collect. Dirt or anything that closes the ducts of the fat cells may bring on an attack of blackheads, pimples, or an eruption called acne.

Milk is often used instead of water in cleansing the face. This is an injurious practice. Usually the skin is greasy in the case of acne, and milk simply increases this condition. Acne is likely to be accompanied by an infection, and milk on the skin is favorable to the growth of injurious bacteria. Irritation from powder rubbed into the skin is often a cause of acne.

It cannot be repeated too often that the face is best cleaned by water and soap. There are thousands of people who have the curious idea that soap and water injure the face. They use creams and lotions that make the face greasy, and they coat the skin with powder. This is really an unwise practice, for it does no good. Use soap and water. The highly advertised and expensive soaps are unnecessary. Generally there is nothing better than a good brand of Castile soap. Those suffering from acne should wash the face with cold water and soap several times a day. Cold water has a tonic effect on the skin. On retiring, warm water and soap may be used, followed by cold water. It should be said emphatically that there is nothing like soap and water for keeping the face clean.

Often acne is caused by eating improper food. Overeating of sugars, starches, fried foods, gravies, and sauces is sometimes responsible. Most people do not drink enough water. It is essential that the bowels be kept open.

In conditions in which the skin is very dry owing to a lack of secretions from the fat glands, cold cream, almond oil, or olive oil should be used instead of water. Although many people think that their skins are overdry, this is a condition seldom encountered in health.

X rays and ultra-violet rays are now being used effectively for skin troubles. Advertisers are now recommending the use, by the layman, of the ultra-violet lamp. This is dangerous. It should never be used except by physicians trained in its use.

When trouble with the skin does not yield readily to simple hygienic treatment, a dermatologist, or skin specialist, should be consulted.

208. Freckles. When the pigment, or coloring matter, of the skin is deposited in tiny areas here and there in the

skin, these spots are called freckles. Freckles are the result of nature's efforts to screen out the powerful rays of the sun. People a generation ago used to wear broad-rimmed hats and veils and carry parasols to prevent or get rid of freckles, but today freckles and tan are generally understood to be indications of a healthful outdoor life.

209. Warts. Nearly everybody is familiar with the superstition that warts are caused by touching toads, but the real cause of warts is unknown. Some reliable authorities think it probable that warts, excepting the flat variety, are caused by germs, are contagious, and can be transmitted from one area of skin to another. They can be removed by the application of caustics, such as nitric acid and caustic potash, but the safer and better way is to consult a skin specialist. Warts that get sore and have collections of pus should always be referred to a physician.

210. Boils. When pus germs gain entrance to the skin through such natural openings as hair sacs, sweat glands, or oil sacs, boils often result. Nature responds promptly to the infection. Although the germs may be at first confined to a sac, they are apt to spread beyond its limits. To prevent the spread of the infection a wall of cells is built around the affected area. There is an engorgement of the blood vessels and a concentration of the serum and the white corpuscles. In the battle which takes place pus forms and pushes itself toward the surface. Finally the skin breaks, the pus drains off, and the opening fills up rapidly with healthy tissue and heals, leaving a scar.

The presence of a single boil is of little consequence, but if they continue to appear it is usually a sign of a run-down condition or other constitutional disorder, and

a physician should be consulted. A carbuncle is a number of closely grouped, deep boils. Carbuncles are likely to be very painful and sometimes are very serious.

It is a common error to think that boils and carbuncles should be lanced. Too often this happens, and the cutting of the hard rim permits the infection to spread. The main thing to remember in the treatment is the insistence upon asepsis and antisepsis. The boils and the skin around them should be washed with soap and water several times a day. After the washing, alcohol and water or boric-acid solutions should be dabbed on lightly. Antiseptic dressings should then be applied.

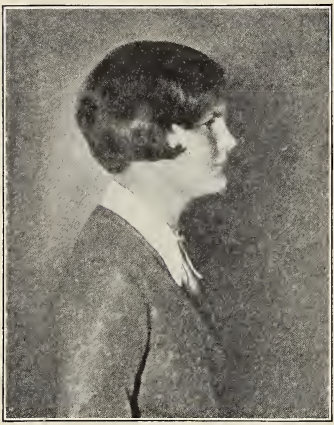
To prevent boils, keep the bowels open and keep the skin clean. Yeast helps somewhat, and inoculations may stimulate the defensive forces of the body.

211. The hair and what it does. A head of thick, glossy hair is one of the distinguishing marks of a good-looking person. When the hair begins to get gray or fall out, its worth is realized and people often resort to questionable methods to restore its natural color and to retain it. Some of the methods resorted to would never be considered if more were known about the hair and its work.

When a hair is examined under the microscope, it is found to have three layers. The first layer is composed of smooth, flat, transparent cells overlapping one another very much like shingles on a roof. This layer forms a protection for the inner part of the hair. The second layer, or cortex, has elongated cells and gives the hair its flexibility. The small openings in the cortex hold oil and give it sheen. Without this oil the hair would be dry and dull. The coloring matter in this layer shows through, giving the hair its characteristic color. The third, or

central, layer is the narrow medulla, or pith, which has two rows of cells placed side by side lengthwise of the shaft. Contrary to common belief, this medulla is not hollow.

At its lower end each shaft of hair swells into a bulb, or bowl, which fits over the papilla, or projection in one of the layers of skin. It is through the papilla that the hair gets its blood supply and nourishment. In connection with each hair follicle, or sheath into which the hair fits, are tiny muscles that tend to raise the hair erect. The tendency is very marked in the case of the cat who "gets her back up." These muscles, by contracting, also cause goose flesh.



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BEAUTIFUL HAIR

The result of good health and care

Every hair, if permitted a normal growth, attains its full length, drops out, and is replaced. In the life of a hair there are alternate periods of rest and growth.

The hair today is less useful in a protective way than it was in primitive times. Then it protected the head against cold, dampness, and bumps. Today clothes and hats provide insulation against extreme temperatures and protect the head, but the need of healthy hair today from a decorative point of view is as great as ever.

212. General good health promotes the health and beauty of the hair. Just as a bud on a tree depends on the limb or trunk of the tree for its healthful development, so the hair depends on the body. The hair depends on the circulation for its nourishment, and therefore anything that affects either the quality or the quantity of the blood affects the hair. Health is one of the essentials for good, nourishing blood. The practice of the various rules of health, like eating nourishing food, getting plenty of sleep, wholesome recreation, etc., is conducive to the healthful development of the hair. No treatment of the hair is likely to be effective unless there is first general bodily health.

213. Care of the scalp. The scalp is probably dirtier than any other part of the skin surface. It not only retains the dust and soot from the atmosphere, but it also conceals and holds the secretions from the sweat and oil glands and the scales from the skin that are thrown off in abundance, particularly when there is infection present. In spite of these facts many people, perhaps most people, think that the hair should be washed as little as possible. They may clean the teeth three times a day and take a daily bath, and yet wash their hair only once in two or three months. As a rule, the scalp should be washed once or twice a week. Despite old-time beliefs, washing does not hurt the hair. Under proper conditions washing removes dirt, scales, dust, and grease, and decreases the liability to infection. The ideal in cleanliness of the scalp is to maintain the same cleanliness as on other surfaces of the body.

Neutral soaps of well-established brands are fully as good as the more expensive and medicated soaps for shampoo purposes. A good Castile soap in liquid form

is best and most convenient. The following rules summarize the most important points on shampooing:

Wet the scalp thoroughly.
Rub on soap until a thick lather is formed.
Knead this into the scalp with the tips of the fingers.
It is not necessary to leave soap in the hair for ten or fifteen minutes.
Rinse thoroughly.
Rinse several times alternately with hot and with lukewarm water until every bit of soap is removed.
The last rinsing should be with cold water, to stimulate the circulation of blood in the scalp and to close the pores.
Dry the hair at once with towels. Combing the hair with the fingers and shaking the hair while drying it is a good practice.
To prevent extreme drying of the scalp, the white of an egg may be rubbed into the hair or added to the shampoo water. This treatment also increases the gloss. Unusual dryness and hardness of the scalp may be overcome by rubbing into the hair olive, almond, or coconut oil.
Unusually greasy hair may be rubbed with cologne water and immediately dried.
It is a good practice to dry the hair in the sun.
Each member of the family should use only his own comb and brush.
Avoid patronizing beauty parlors or barber shops where brushes and combs are not sterilized.
Combs and brushes may be sterilized at home by boiling them or soaking them in a solution containing one teaspoonful of formalin to a pint of water.
Use combs with smooth, blunt teeth.
Metal combs and fine-toothed combs should not be used.

214. Gray hair. After the hair has turned gray there is no treatment that will restore it to its natural color. Dyeing the hair is not recommended, since it is often

injurious to the scalp. Grayness of the hair may be due to some illness or to a diseased condition of the scalp, or it may be simply the accompaniment of years. Often it seems to be hereditary.

Something can be done to prevent premature grayness by caring for the scalp and the general health. When the first gray hair appears, the condition of the body should be looked after at once. At such a time it is wise

THREE FRIENDS WORTH HAVING

to consult a hair specialist. It should be remembered that beauty parlors are usually run by people who have had little training in science and may have unsanitary habits.

215. Baldness. The falling out of the hair may be prevented to a considerable extent by the proper care of the scalp and by the maintenance of the general health. Like grayness, it often seems to be hereditary. Dandruff, grayness, and baldness may be due, to some extent, to an infection of the scalp. If the ordinary means of caring for the general health and the scalp and hair do not suffice, it is always best to consult one's family physician or a specialist.

216. Care of the hands and nails. There are at least two very good reasons for the proper care of the hands. In the first place, properly groomed hands are marks of refinement and are necessary for advancement in many professions. Any boy or girl, man or woman, who habitually has dirty hands and unkempt finger nails will find such conditions a serious handicap in business. Many a person has lost the chance to secure a position or to be promoted, because of dirty finger nails or grimy hands.

AN ATTRACTIVE HAND
Can you tell why?

Secondly, the hands should be kept in a hygienic condition because they are likely to be contaminated and convey disease, especially in eating. They should be washed carefully after each visit to the toilet and also before eating.

The hands are quite tough and will stand a good deal of washing. A hand brush may be used effectively. It should be neither too soft nor too hard, and ought to be sunned frequently in the open air.

The nails, which, like the hair, are outgrowths of the skin, need especial care, since their point of contact with the skin is delicate. The skin tends to hang to the nail and then become stretched and torn. Serious infection may result. A blunt orange-wood stick may be used to

push the skin back around the base of the nail. A good time to do this is after the bath. If the skin in contact with the nail gets too dry, it may be softened by allowing cold cream to remain on it all night. If hangnails form, they should always be carefully cut rather than pulled away. It is better to file than to cut nails. Long, pointed nails should be avoided, since they tend to break. The filing of the nail should follow the natural curve of the finger tip. A narrow margin of white should extend beyond the red bed of the nail.

A SECTION OF THE END OF A FINGER, SHOWING THE NAIL

217. Good books for reference. Fortunately some excellent books on the skin and hair are to be found in many school and city libraries. Try to find them in your school library first. This is the list:

LEVIN, OSCAR. Your Hair and your Health. Greenberg, New York.
LEVIN, OSCAR. The Care of the Face. Greenberg, New York.
PUSEY, WILLIAM A. The Care of the Skin and Hair. D. Appleton and Company, New York.
STRICKLER, ALBERT. The Skin: Its Care and Treatment. D. Appleton and Company, New York.

Try This

Write a brief important statement about each of the following. Think hard. Do your best.

1. The desire to be good-looking.
2. Beauty and the condition of the face.
3. The first layer of the skin and its function.
4. The second layer of the skin and its function.
5. The third layer of the skin and its function.
6. Three things that the skin does.
7. Why the general health affects the skin.

8. What a blackhead is.
9. The prevention of blackheads.
10. The cure of blackheads.
11. Washing the face in milk to insure a good complexion.
12. The treatment of warts.
13. What causes a boil.
14. The treatment of boils.
15. The first layer of the hair.
16. The second layer of the hair.
17. The third layer of the hair.
18. The use of the hair.
19. The relation of the hair to general health.
20. Keeping the hair clean.
21. A good shampoo.
22. Gray hair.
23. How to manicure the nails.
24. The prevention of hangnails.

Interesting Things to Do

1. Examine a hair under the microscope. What do you see?

2. Examine a bit of skin under the microscope. What do you see?

3. Show the class a well-manicured set of finger nails.

4. Look through the files of *Hygeia* and report to the class on quackery in connection with the hair and skin. If *Hygeia* is not available, write to the American Medical Association, 535 North Dearborn Street, Chicago, for free literature on patent medicines and the hair and skin. Report to the class.

5. Make out a list of the habits that are necessary in order to keep the face healthy. How many of them have you formed? How many of them will you form this year? Consider also the habits necessary for the care of the hair and the nails.

CHAPTER XVII

DRESS FOR HEALTH, COMFORT, BEAUTY, AND ECONOMY

218. Our standards of dress. It is a fact accepted by intelligent people that our dress should make for health, comfort, good looks, and economy. In actual life we find that these standards do not have as much influence as we might imagine. Notice, for example, the young lady who wears very high-heeled shoes. To keep her balance she must assume an ugly posture. Wearing such shoes will not tend to make her healthy, comfortable, or beautiful. Observe also how we buy new coats and hats not because ours are worn out but because they are not in style. Nobody, of course, wants to look odd as compared with other people. If we do not adopt extreme styles of dress, we shall find that it will be possible for us to wear our clothes longer and still be not very different from other people.

Although these standards of dress are frequently violated today, our dress is much more comfortable than it was fifty or one hundred years ago. Present-day fashions demand comfort except with a few things, such as stiff collars for men and formal dress in hot weather.

219. Clothing and the temperature of the body. In Chapter XI we noticed how important it was that the body should keep its normal temperature of 98.6° F. Wearing the right kind of clothing is therefore of great significance for health.

For protection, clothing should be adapted to seasonal changes in air conditions and to convenient alternation between outdoors and indoors. The weight should be always just sufficient for perfect comfort. If we could be comfortable with less clothing, we are too heavily dressed for health.

Indoor clothing should be suited to indoor temperatures. Since our living rooms in winter are kept at summer heat, clothing should be of light weight, porous, and washable, in winter as in summer. Adaptation to outside weather is made by the addition of heavy wraps and hand and foot coverings. To sit in a warm room with heavy clothing on and to go outdoors insufficiently protected against cold are equally injurious.

Wool is the warmest fabric, because it is the poorest conductor of heat and therefore keeps the heat of the body from being conducted away to the cold air outside. Cotton comes next, then rayon, silk, and linen. The last three are cool fabrics because they are good conductors of heat. Woolen underwear and stockings are the appropriate wear for rooms that are unevenly or insufficiently heated, or for severe outside cold.

The vigor of the wearer is an important factor in determining the weight and material of clothing. Some persons in vigorous health need a great deal less clothing, either indoors or outdoors, than others with less resistance. It is usually true that boys and girls who need more clothing than their companions in order to be comfortable indoors have poor circulation. They will find, doubtless, that they are also exercising less than the others, and that they do not react with a healthy glow after cold shower baths. Study your own needs and dress accordingly.

LADIES' DRESS OF BYGONE DAYS

Compare these styles with those of today as to beauty, comfort, and health

Clothing must be porous. Summer or winter, indoors or out, the skin perspires, and this moisture must be allowed to evaporate into the air. This, as we learned in Chapter XI, is the basis of the heat regulation so essential to the health of the body.

Cleanliness is therefore a health essential as well as an essential of good taste. Clean clothing is more porous, and allows freer circulation of air and moisture.

Uniformity of clothing is a most important essential. Clothing should cover the body evenly. If one part is warm and another uncovered or thinly covered, the circulation of the blood is thrown out of balance, and a surprising number of uncomfortable effects can follow. Most harmful is the wearing of underwear that leaves part of the skin unprotected while other parts are adequately clothed. The wearing of furs around the neck is likewise unhygienic, since it creates unevenness of body temperature.

For winter outdoor wear coats, gloves, overshoes, and stockings should be adequate for perfect comfort. Especially to be avoided is the chilling of some one part, as when one goes without gloves or wears chiffon stockings while the rest of the body is adequately clothed.

Hygienic clothing permits freedom of movement in all parts of the body. Tight bands, belts, and garters are all injurious. Anything sufficiently tight to hold a garment in place constricts the blood vessels and nerves.

The fashion of knickers and sweaters for girls as well as boys, for outdoor sports and hikes, is a most healthful one. Even a short skirt does not give the freedom of knickers.

The same principles which governed Commander Byrd's careful planning of clothing for the members of his arctic

GENTLEMEN'S DRESS OF BYGONE DAYS

Is it as practical and healthful as the dress of today?

expedition apply to winter clothing anywhere. The outer garment is of reindeer skin, which is nonporous, keeping the wind out and the warmth of the body in. Next inside they wear an inner suit of fawn skin, — very loose and soft. This gives a layer of warm air between the outer and inner garments. The fur, being inside, makes a thick, soft blanket which holds the warm air next the body and yet allows evaporation to take place.

COMMANDER BYRD

Dressed for his adventures in the Antarctic

While we do not need to wear reindeer skin in winter, the essentials of outdoor clothing for cold weather are the same. It should be loose and warm, and the inner layers should be porous.

The color of clothing affects temperature. White is the universally suitable summer color, because white is the result of the reflection of all the rays of light; black is the warmest color, because it is the result of the absorption of all the rays. An easy demonstration of this difference in the heat-absorbing powers of colors may be given by laying on a piece of ice, outdoors in the sun, pieces of cloth of the same kind but of different colors. White, black, red, and blue would be an interesting selection. Note that the ice melts most quickly under the black cloth and most slowly under the white. If the red and blue are pure colors, the ice under the red will melt more rapidly than that under the blue.

220. Beauty in clothing. Clothing as a means of adornment is a most important consideration. One's best points of coloring and build should be taken into consideration in planning clothing, and these lines and colors accentuated. It is also important to avoid calling attention to extreme characteristics. The very tall girl or boy will not wear patterns with long, unbroken, up-and-down lines, nor will the fat ones use round-and-round lines. The colors in the costume should repeat the colors in the complexion, hair, or eyes. A touch of color in the dress brings out the corresponding tint in hair or skin or eyes. A color chart made with the help of the art teacher will give you a surprisingly wide range of coloring to choose from. A little of this study of the real art of color selection will leave no desire to cover nature's appropriate and subtle blendings of hue and light and shade with inartistic rouge and lip stick. Extremes in dress should always be avoided.

221. Economy in clothing. One great secret of being well dressed on a limited budget is the choice of a basal color and one or two accessory colors for decoration. If this color plan is adhered to year after year, things always go together, whether bought the same season or not. The colors are those that repeat tones of the complexion chart.

222. Interesting tests of fabrics. Boys as well as girls like to know that they are buying a suit that will not wear shiny or sag after a few weeks of wear. A few experimental tests of fabrics, which will enable one to judge the value of a fabric, are interesting to perform, may prove useful, and can be made at home.

To distinguish cotton from linen, put a small drop of ink on each. Note that the ink spot becomes rapidly larger on the linen, while on the cotton cloth it spreads much more slowly.

To distinguish wool, burn a small piece; the characteristic odor cannot be mistaken.

To tell whether a silk or a wool fabric is mixed with cotton, boil the sample for ten minutes in lye (a 10 per cent solution of sodium hydroxide from the druggist will do, or any strong household alkali, such as washing soda). The silk or wool fibers will be dissolved in the boiling alkali, and only cotton will be left. If the fabric all dissolves away, it was pure silk or pure wool, or both.

A TEST FOR WOOL

Often a mineral filling, or sizing, is used to increase the body, or weight, of fabrics, particularly of silk. To test the presence of this filling, burn a piece over a flame. If sufficient ash is formed to keep the shape of the piece of fabric, it is heavily filled and would not wear well. The amount of filling may be determined by weighing a piece of cloth, boiling it in several changes of water for half an hour, drying it, and weighing it again. The amount of weight lost indicates the amount of filling that was present.

True or False?

Read each of the following statements with care. Is it true or false? Why or why not? Support your reasons by facts.

1. Dress should be comfortable.

2. If dress is comfortable, it is likely to be healthful.

3. In buying clothes everybody thinks of comfort first.

4. If clothing is cheap in price, it will not be beautiful or healthful.

5. Variations in bodily temperature are not important.

6. Men's clothing is much more comfortable than that of women.

7. We need to choose our clothes wisely so as to keep cool in summer and warm in winter.

8. Underclothing ought to be much heavier in winter than in summer.

9. It is a good plan to wear sweaters in the schoolroom.

10. It is expensive to adopt extreme styles.

11. A garment of cotton weighing just as much as a similar garment of wool is just as warm.

12. Linen is cooler than cotton.

13. Porous cloth is warmer than nonporous.

14. Different people require different weights of garments to keep warm.

15. Tight garters are not injurious to health.

16. White clothing is cooler in summer than dark clothing.

17. Dress should be planned so that its color will harmonize with the color of a person's hair, eyes, and skin.

Interesting Things to Do

1. Perform all the tests described in this chapter.

2. Make a scrapbook of pictures of healthful dress.

3. Plan for a style show at school. Compare our own simple and healthful clothing with fashions of other days. Include the present costumes of other countries. Bring in history, art, and hygiene.

CHAPTER XVIII

MAKE YOUR NERVOUS SYSTEM YOUR FRIEND

223. A helpful invention. The invention of the telephone marked a new epoch in the affairs of mankind. It was one of the first of those remarkable inventions that were to bring people closer together and so eliminate time and space. It gave man another of the tools which he needed to acquire the mastery of the world. But, outside of its usefulness to man, it was remarkable because it helped to explain one of the most complicated parts of the body, the nervous system.

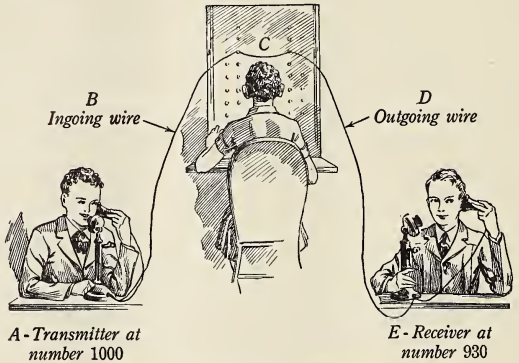
224. How the telephone works. Let us see how a telephone works. Suppose William, whose number is 1000, wishes to call up Laurence, whose number is 930. William speaks into the transmitter *A*, the tube which receives the voice, and says "930, please." His message is carried along a wire *B* which leads to a central station, or exchange. Here the telephone operator at *C* connects the ingoing wire with the proper outgoing wire *D*, and the message is carried to Laurence at number 930. In the most progressive telephone systems today the connection may be made automatically at *C* without the aid of the telephone operator. In a real telephone exchange the switchboard is much more complicated than our illustration would indicate. There is a possibility of making thousands of connections and also of making use of other exchanges.

225. How the nervous system works. It is remarkable how the nervous system resembles the telephone system.

Read slowly, and study the illustration on page 273. When one burns his finger on a hot stove, many tiny sense organs are stimulated in the skin at *A*. This impulse passes along an ingoing, or sensory, nerve *B* to the spinal cord. Here you will notice that the nerve fibers end in delicate branchings, as at *C*. Notice the outgoing, or motor, nerve *D* and the associative mechanism in between *C* and *C'*. Look at the figure on page 272. Make comparisons between the connecting mechanisms. The points *C* and *C'*, where the branches of two nerves come close together, are called synapses. This is where the connection is made. The impulse jumps across the synapse at *C* and also at *C'* to the outgoing, or motor, nerve *D* and travels to the muscle *E* in the arm, which is immediately drawn away. This action takes place quickly, before we have time to become conscious of the sensation. It is called a reflex act. The winking of the eye is a good example of a reflex act.

Not every sensation received through the skin is transferred immediately into action. The message may travel upward to the brain (see arrow). Here the nerve cells of the brain are stimulated, and we become conscious of the sensation and may remember others like it; an impulse may then travel downward from the brain to a muscle. For example, a boy feels a coin in his pocket. The stimulus passes to the brain and arouses in his mind the question, Is it a penny or a dime? Memory tells him that it is too thick to be a dime and is probably a penny. As a result he decides to pull it out and look at it. An impulse then travels down from the brain to the muscles of the hand, and he pulls the coin out for examination. Even our simplest acts are very complicated and usually involve many more synapses than are indicated in the illustration on page 273.

226. The centrals of the nervous system. Probably the most remarkable mechanism in the world is the nervous system. Chemists have discovered that the chemicals in the human body could be bought at a drug store or chemical-supply house for about 98 cents, but no human ingenuity could organize these chemicals into any sort of contrivance that could operate like the human machine.



HOW A TELEPHONE OPERATES

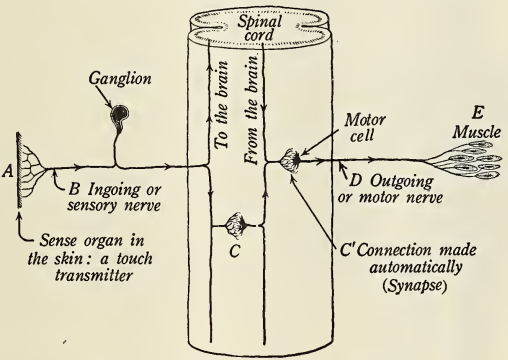
The connection is made at *C*

The most important part of any machine is the directing and controlling part of it. In the human body it is the nervous system that controls.

The billions of nerve cells that are found in the human body are organized into two great systems. The one we hear most about is the central nervous system. It has four main organs, or central switching stations, — the cerebrum, cerebellum, medulla, and spinal cord.

The cerebrum, or large brain (see the illustration on page 274), is the most important part of the central nervous

system. It is symmetrical in shape and is divided into parts called hemispheres. It resembles in form the meat of an English walnut. The outside of the brain consists of a thin gray layer of cells, the cortex. Since man needs more cells than the lower animals, it is thrown into folds to make room for them. The brain is protected by the



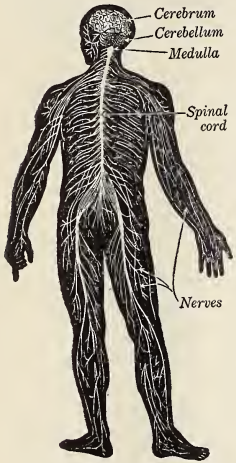
HOW THE NERVOUS SYSTEM OPERATES

Connections are made at *C* and *C'*. Study this diagram carefully as you read section 225

bones of the skull that are joined together to make a very strong box. Between the brain and the skull there is a watery fluid that protects it from shock.

The cerebrum is the seat of our conscious life. Without it we could not have thoughts, ideas, imagination, or ideals. It is the seat of self-control. Narcotics like alcohol, opium, and morphine directly affect the cerebrum. One of the first effects noticed after using such drugs is a lack of self-control which ordinarily shows itself in indiscreet speech and indifferent manners.

The cerebellum, or little brain, is below and at the back of the cerebrum. It has something to do with keeping our balance and with the correlating of muscular activities like walking and running. One of the secondary effects of the taking of a narcotic is stumbling and staggering.



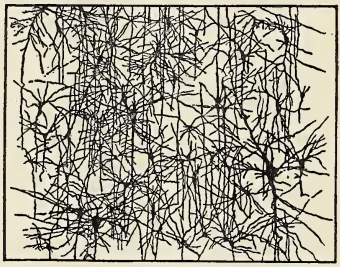
THE NERVOUS SYSTEM

The top of the spinal cord is broadened out into a triangular enlargement called the medulla. Here are the cells that govern many of the automatic and unconscious activities. The rate of the heartbeat and of breathing are controlled from this center. When we exercise, the amount of carbon dioxide in the blood increases. This carbon dioxide irritates the medulla, which in turn increases the action of the heart and the lungs.

The spinal cord extends down the back through a canal hollowed out in the vertebræ of the backbone. It controls many reflex, or unconscious, activities and also carries messages to the brain through its long fibers.

The autonomic nervous system is composed chiefly of groups of nerve cells, or ganglia, distributed along the spinal column. Unlike the central nervous system, which is connected with the voluntary muscles and controls conscious action, it is connected with the involuntary muscles and is entirely beyond the control of consciousness. The autonomic system has much to do with the control of the vital activities, such as digestion and circulation.

227. Habits are formed at the synapses. The nervous system is much more complicated than the illustration on page 274 would indicate, since it is made up of such a vast number of nerve cells. Any sensation, when it goes to a central station, has a chance to go over one or more of a number of switches. Suppose, for example, that a young man meets a lady on the street. He may stop or walk on, lift his hat or keep it on his head, say "Good afternoon" or pass without speaking. What he will do depends on the switch that he chooses. Suppose that the switch, or synapse, at *A* leads to the muscles that he uses in tipping his hat. If he connects the switch at *A*, the muscles will lift his hat; but if that switch is disconnected, he may connect at *B*, which leads him to walk on. What we are going to do at any time depends on changes at the synapses.



SECTION THROUGH THE CORTEX OF THE BRAIN

After Kolliker

There are two interesting laws of learning, or habit formation. The first is the law of use. If a boy lifts his hat when he meets a lady, thus using connection *A*, it will be easier to do it the next time. If he has not been accustomed to this form of politeness, he may be quite conscious of it and embarrassed; but as time goes on, and as he practices or uses this connection, it becomes as natural as breathing. Nobody knows just what happens at the synapse, but we do know that finally the connection works like any automatic machine, without conscious effort.

The other law is the law of effect. When we do a thing and it gives us pleasure, we tend to repeat it; but if it is painful, we are less likely to do it again. There is an old saying, "The burnt child dreads the fire." This could be accounted for by the law of effect.

228. Building our mental machinery. Unlike a mere machine (an automobile, for example), we can train ourselves and so form our character. To a very great extent we can decide what kind of person we desire to be, and then practice to become that person. If you do not like salad, the probability is that you have not tried seriously to make over the connections in your nervous system so that you could eat it with pleasure. Great students of nutrition, like Dr. McCollum, tell us that the habit of eating salads is so desirable that it would be well for us to eat two salads a day. If you do not like salads, it is probable that you find the French or mayonnaise dressing offensive. To learn to like salads with dressing on them, first make up your mind that you *will* like them. Do not give up after the first experiment. At first try to eat a small salad. It may be only a lettuce leaf. Put on it just enough dressing so that you can taste it. It might be desirable to begin with a cooked salad without oil. The next time you have a salad, do the same thing, and then gradually increase the amount of salad and also the amount of dressing. As time goes on, you will notice that the eating of salads becomes more and more attractive, and finally you would not think of doing without the dressing. If you have the spirit of good sportsmanship and continue in this way, you will eat salad as a matter of course. You yourself will have made your nervous system your friend. You can educate your nervous system so that it will be the natural thing to clean your

teeth, go to the dentist, eat nutritious food, and have good posture. It is your problem. If you haven't solved it, will you?

229. Developing traits of character. If you wanted to develop the muscles of your arm, you would use them. Notice the arm muscles of the blacksmith, farmer, or athlete who uses his muscles. In the same way we can develop any trait of character. Suppose, for example, that you wished to develop friendliness. Here are some of the things you might do:

Keep saying to yourself that other boys and girls are as anxious to get acquainted with you as you are to get acquainted with them.

Avoid having haughty airs; they repel.

Do not wait for others to speak first; be the first to say "Good morning."

The time to show friendliness is when somebody is in trouble. When your classmates or people around you need your help, be quick to offer it.

Be thoughtful of the wishes of others.

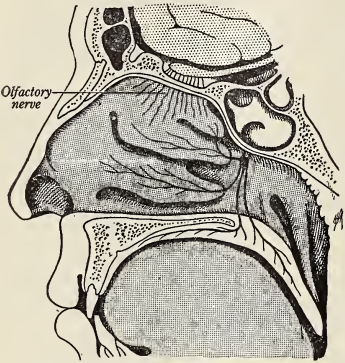
Practice the golden rule, "Do unto others as you would be done by."

Perhaps you will think of other things that you may do to further your spirit of friendliness. If you wish to improve, you will practice. It is important to have traits such as honesty, courtesy, self-control, and friendliness. They help us to get along with others and also to be happy. This is another way of making your nervous system your friend.

The next chapter tells us more about the habits that we need to form in order to be in good mental health.

230. General care of the nervous system. The nervous system, like any other part of the living body, is made

up of cells which are dependent for their well-being on nutrition, oxygen, rest, sleep, and freedom from drugs. Everything that tends to make the body generally healthy promotes the health of the nervous system. Since what we call the mind depends on the healthy nervous system, it is clear that right living will help us to study, work, play, and enjoy life.



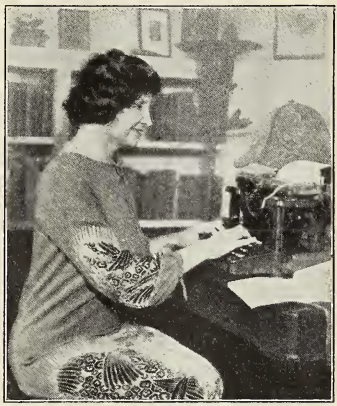
A VERTICAL SECTION OF THE NOSE

The olfactory nerve carries the sensations of smell to the brain

As we have already noticed, we can train our minds according to the way we use them. Some people get into bad habits of worrying about disease instead of thinking about health; of trying to get around difficulties instead of meeting them bravely. One may be unhealthy because he has not trained himself in the concentration of attention on his work. Some of the habits that promote a healthy mind will be taken up in the next chapter.

231. The sense organs tell us about the world. So far we have been learning mostly about the switching stations of the nervous system. These could not work to our advantage without messages from the outside world and from within the body itself. Through sense organs we see, hear, touch, taste, smell, and feel hungry, tired, and thirsty. When we are ill they report to us a different message from the one they report when we are well. It

is only as we know something about the condition of our bodies and the outside world that we know what to do. When we are tired we may rest, and if it rains we may carry an umbrella. If the sense organs are not accurate in their messages, we may get into trouble and suffer much discomfort and pain. Let us learn something about the principal sense organs, or receptors. As we shall see, each one is adapted to receive a particular kind of stimulus.



HELEN KELLER

The famous deaf, dumb, and blind girl who learned how to talk and read. She learned how to use her remaining senses so well that she graduated from college

232. The sense of smell. The nerve endings for smell lie in the thin mucous lining of the nose. The receptors of smell and taste are acted upon by many of the same substances, but it has been shown that alcohol, which has both taste and odor, must be 24,000 times stronger to affect the taste buds than to affect the smell receptors. The delicacy of the sense of smell is such that the merest whiff of alcohol diffused in the air is smelled but cannot be tasted. Substances to be smelled must be in gaseous form; to be tasted, in liquid form.

Helen Keller, the famous deaf and blind woman, who was educated through other senses than sight and hearing, finds her sense of smell very valuable. In her own words:

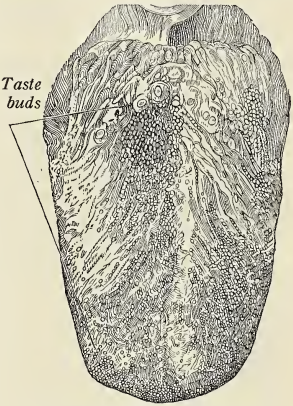
> The sense of smell has told me of a coming storm hours before there was any sign of it visible. . . . I know by smell the kind of house we enter. In the evening quiet there are fewer vibrations than in the daytime, and then I rely more largely upon smell. . . . Smell gives me more idea than touch or taste of the manner in which sight and hearing probably discharge their functions. . . . From exhalations I learn much about people. I know often the work they are engaged in. The odors of wood, iron, paint, and drugs cling to the garments of those that work in them. . . . I have not, indeed, the all-knowing scent of the hound or wild animal. . . . Nevertheless, human odors are as varied and capable of recognition as hands and faces. The dear odors of those I love are so definite, so unmistakable, that nothing can quite obliterate them.

Civilized man seems to have lost in large measure his keen scent, but he still finds smell useful in learning about his surroundings. Decay and mold are often readily detected through smell. It often protects us against dangerous food. The first steps in the spoiling of fish and meat can often be discovered through the sense of smell when sight would not be helpful. An appetizing odor helps us to enjoy our food and stimulates the flow of the saliva. Smell also helps us to enjoy beautiful things. The odors of fields, flowers, and the sea have become a part of the language of poets.

233. The sense of taste. Taste impressions are received by nerve endings in the tongue. These endings are wrapped around special groups of cells which are sensitive to substances in solution. Such a bunch of cells is called a taste bud. In adults these buds are located chiefly under the papillæ, or little raised places on the tongue. Children have more taste buds than adults. After our

likes and dislikes are fixed for life we probably do not need fine discrimination in flavors as we do while learning to eat.

There are only four kinds of taste: sweet, sour, bitter, and salt. The other discriminations that we make are really differences in smell and in the feeling of the texture of the food by the nerves of touch in the tongue, the cheeks, and the roof of the mouth. Professor Titchener says, "The greater part of what we eat is tasteless."



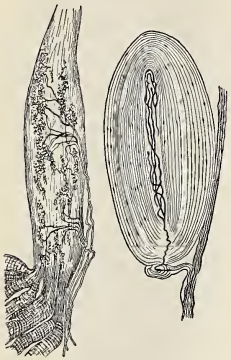
THE TONGUE, SHOWING THE TASTE BUDS

234. The sense of touch. We become conscious of contact and pressure on the skin through tiny receptors in the skin. The branchings of certain nerve endings there end in tiny bulbs.

Animals differ greatly in their sensitiveness to touch. Some are more sensitive than man. The bats have a very good record. They seem to be so sensitive that they can feel objects before they come in contact with them. About two hundred years ago a scientist stretched a maze of strings crisscross through a large room. The strings were fastened to bells which rang when the strings were touched. Bats were let loose in the room in the bright sunlight (when bats are blind), and though they flew all about among the strings, not a bell was rung. The bats actually felt the strings before they touched them. In the same way the blind man learns to avoid obstacles because he

feels against his face the slight difference in air pressure when he is approaching a solid object. The bat is covered with exceedingly fine hairs with special touch organs in the skin at their bases.

Touch receptors, buried deep among the muscle fibers, where they are affected by the contraction of muscles, bring us many interesting messages about pressure and weight.



NERVE ENDINGS IN A MUSCLE, AND A SENSE ORGAN OF TOUCH IN THE SKIN

The sense of touch is more reliable in some ways than that of sight. When we are looking at a fabric, we usually wish to take hold of it and feel of it with our fingers.

235. Warmth and cold. These are two separate sensations, taken up by different nerves with two special kinds of endings. Scientific workers have shown that each of the four skin sensations (warmth, cold, touch or pressure, and pain) comes from a different spot on the skin. Mark off an area on your own skin and then go over this area carefully with a blunt needle, applying it with equal pressure. In some places you will feel contact; in others, there will be no sensation. Go over area with warm or cold nail. Notice result. Anatomists have proved that there are tiny nerve endings at the spots where we feel warmth, quite different from those at the spots where we feel cold, or pressure, or pain.

236. The sense of pain. Pain is the fourth of the special senses located in the skin. It is surprising, at first thought, to find that, of the four kinds of nerve endings in the skin,

pain is so much the most abundant. One scholar gives the relative abundance of the four kinds of nerve endings in the skin as follows: heat, 30,000; cold, 250,000; touch, 500,000; pain, 4,000,000. The reason for this large number is the importance of pain in protecting us against injury. Pain is a real danger signal. Pain should not be deadened or covered up by drugs, but the cause should be discovered and removed. There are times in acute illness when the pain must be relieved to give the patient rest enough to keep up the necessary strength for combating the disease. This, of course, is given under the direction of a physician. Headache powders, aspirin, and soothing sirups, or anything else to relieve pain, must be taken only as directed by a physician. We should form habits of courage in meeting pain, so that we may not become slaves to drug habits which may sap our vitality and make it impossible for us to be happy or successful in life.

237. Internal sensations. There are sense organs which keep us informed about the conditions within the body. The most important of these internal sensations are hunger, thirst, nausea, visceral pain, and equilibrium.

Hunger is the news sent to the brain that the stomach is empty. Its receptors are those which register pressure in the contracting muscle cells of the stomach. One reason why we become hungry sooner after a meal of vegetables than after a meal which includes meat is because the stomach is emptied sooner in the case of the vegetable meal. The contractions of the walls of the empty stomach result in hunger.

The special sense organs involved in thirst have not been discovered. Thirst is the impression carried to the brain of lack of sufficient water.

Nausea is an uncomfortable sensation felt when the food tends to be reversed in the alimentary canal. It sometimes helps the digestive system to get rid of improper food.

The internal organs also have pain receptors, similar to those found in the skin. They give reports when something goes wrong. It is rather interesting that there are few pain receptors in some of the vital organs, such as the heart. These *must* go on working whether they are sick or not.

The sense of equilibrium enables us to keep our balance and to maintain a correct posture. We have power to do this because of a special part of the ear, which has no more to do with hearing than it would have if located in some other part of the body. This special part of the ear is similar to the spirit level with which carpenters and masons test their work. As you probably know, this instrument is a piece of wood which has inserted in the middle of one edge a little glass tube filled with alcohol, in which is a bubble of air. It is made so that when the piece of wood is exactly level, the drop is exactly on the line that marks the middle point. When the level is tilted, the bubble moves one way or the other, enabling one to see a tilting so slight that the eye would never discover it merely by sighting along the object itself.

Our organ of equilibrium is built on this same principle. In the inner ear there are three tubes, the semicircular canals, each with a bulb at one end, filled with a watery lymph. The wall of each bulb has a ridge of very fine, hairlike nerve endings, which project into the liquid. When the head tips, the liquid falls more heavily against the side toward which the head moves. Central is thus constantly kept informed as to the position of the head. The accuracy of this information is insured by having the

three tubes placed at different angles to the body (front-back, up-down, and side to side), so that the least variation of direction is accurately registered. A lack of balance may be recorded as dizziness. It often records a situation that may be dangerous.

238. The sense of hearing. The ear is one of the most complicated of the sense organs. Let us look at the illustration on this page and try to understand how we hear. The external part of the ear, made of flexible cartilage and skin, is constructed so as to direct the sound waves into the ear canal. Wild animals possess well-developed muscles to turn the ears in the direction of the sound. As animals become more completely domesticated and protected they tend to lose the use of these muscles. Occasionally a human being is able to move his ears, — an accomplishment which possibly helped the cave man to detect the approach of food or to escape being eaten himself.

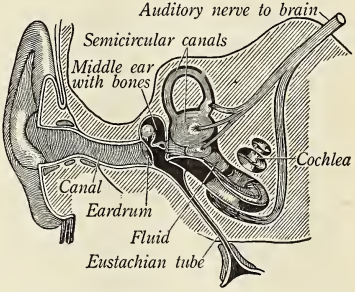


DIAGRAM OF THE EAR, SHOWING HOW WE HEAR

The sound vibrations next pass along the canal. This is filled with a yellowish wax manufactured by the cells that line this tube. This wax prevents dirt and insects from getting far into the ear.

Stretched across the end of this canal is a membrane called the tympanum, or eardrum. This is set in vibration. On the other side of this is a chain of three small bones

called, after their shapes, hammer, anvil, and stirrup. One end of the chain is attached to the inside of the drum, and the other end is fixed to the opposite side of the cavity. These are set in vibration by the eardrum, and they reduce and intensify the vibrations which the drum receives from the outer air. The smallest bone fits into a tiny window, the only opening into the coiled cavity resembling a snail shell, which contains a fluid with hair-like nerve endings projecting into it. These hair cells are set in motion by the waves which the little bone sets up in the liquid; they start the corresponding impulses along the fibers of the auditory nerve, and these are received and interpreted by central in the brain. Thus the miracle of hearing takes place.

In the illustration on page 285 you will notice the Eustachian tube. This leads from the cavity of the middle ear to the throat. If you will hold your nose and swallow, you will notice a peculiar feeling in your ears and will find that you cannot hear so well as usual. That is because you are decreasing the amount of air in this cavity, so that the outside air exerts greater pressure on the outer side of the tympanum than does the air which remains on the inner side. To hear properly, the pressure of the air must be the same on both sides of the tympanum. This, as you can see, is made possible by the Eustachian tube. The tube is closed during quiet breathing but is opened during swallowing, talking, or deep breathing. Often, as you know, we have temporary deafness during a cold. That is because there is an inflammation in these tubes which makes the pressure of the air inside of the tympanum less than the pressure outside. Sometimes there is a ringing in the ears; sometimes an infection may spread to the middle ear and be serious.

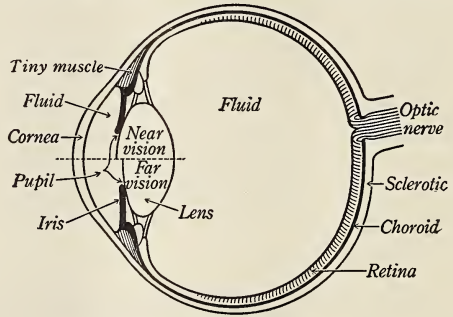
239. Protect your hearing. Probably few of us have thought about the importance of our hearing. There is an old saying, "We never miss the water till the well runs dry." So we do not ordinarily value our hearing, because we have always had it. But think how dreary the world would be if we could no longer hear the voices of our relatives and friends or listen to music. Some persons, however, are somewhat deaf without knowing about it. Today tests of hearing are given in most schools. If you have not had your hearing tested this year, let the members of your class test each other's hearing. Use the voice tests. Stand about twenty feet back of your classmate. Whisper several things to him and ask him to put them down on paper, or tell him to do several things, such as "Bring me a pencil." In many schools a new phonographic device for testing the hearing, the audiometer, is being installed. It is a scientific test of hearing.

Here are a few suggestions as to how you may care for your hearing:

1. If your hearing is defective, go to a physician, preferably a specialist. Often a slight defect may be remedied before it gets to be serious.
2. Avoid colds. They often lead to serious ear trouble. If your ears ache, consult your physician. Running ears are serious. If you consult a physician early enough, they may be prevented.
3. Blow the nose gently by holding the handkerchief to the nose lightly. Blowing the nose hard often leads to forcing mucus through the Eustachian tube into the middle ear and causing an infection.
4. If ear wax hardens in the canal of the outer ear so that it cannot be removed by the index finger, have it removed by a physician. The use of hairpins and other objects is to be condemned.

5. If an insect gets into the ear, he may be attracted by holding a light up to the canal of the ear. If this fails, oil or water heated to about the body temperature should be poured into the ear, and the insect drowned and floated out.
6. Avoid slapping anybody on the ears. The eardrum may be broken in that way.
7. Wash the ears with soap and water every day.

240. The eye, the window of the soul. So much of our learning and enjoyment of life comes through the sense of sight



PARTS OF THE EYE, SHOWING HOW WE SEE

Note the change in lens with near and far vision

that the eye has been called the window of the soul. It is the most complicated of all the sense organs. It transmits light vibrations, while the ear transmits sound vibrations.

If you will study the illustrations on pages 288–291 you will notice that the eye, in its operation, is similar to a camera. The camera is really an artificial eye. Notice that the rays of light are reflected from the object at which we are looking, enter the opening (pupil), and pass through the lens, where they are bent out of their course

because of the thicker gelatinous material of the lens. This bending of the rays of light is blurred if the focus is not perfect. In the camera the image focuses upon the film or plate in the back of the camera. In the eye the retina is the sensitive plate upon which the image is formed when the rays converge. Study the drawing below.

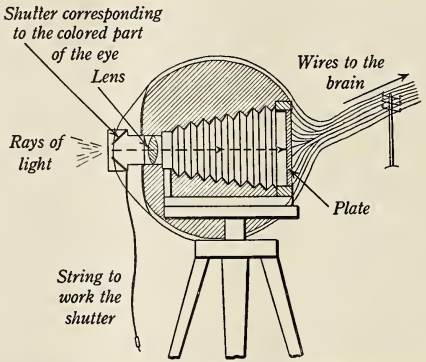
The retina is made up of the ends of the fibers of the optic nerve raveled out and spread into a thin layer which forms the inner coat of the eye. The extreme ends, projecting into the liquid which fills the eyeball, are the rods and cones, and these in some way register the vibrations of the rays of light, transmitting the impulses to the fibers of the optic nerve.

THIS MAN HAS NORMAL VISION

Parallel rays of light are brought to a focus on the retina

The eyeball is covered with a tough, white protective layer called the sclerotic. Over the front this is thinner and transparent, so that the light can enter; this part is called the cornea. When the surface of the cornea or of the lens is uneven, making some parts of the cornea less spherical than others, we have the cause of astigmatism. The middle layer of the eyeball is the choroid, so called because it is colored black with pigment, just as the inside of a camera is black, to prevent the reflection of the rays of light from the inside walls and the consequent blurring of the image. This layer is full of blood vessels and nerves. Over the front of the eye it becomes a circular curtain of muscle fibers, the iris, which is separated from the cornea by a little clear fluid. These fibers are rich in pigment, which gives color to the eye. This iris exactly corresponds to the diaphragm, or shutter, of the camera,

which regulates the size of the opening through which light is admitted. It is made up of two layers of muscular fibers of the greatest delicacy. The outer ones radiate from the center, like the spokes of a wheel. The inner ones run around the opening. When the outer ones contract, the opening becomes larger; when the inner (circular) ones contract, the opening is reduced. The



DRAWING SHOWING HOW A CAMERA RESEMBLES THE EYE

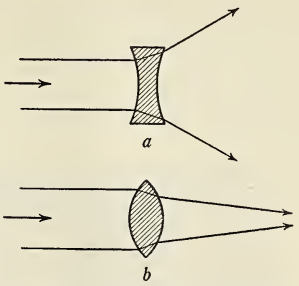
Explain how it works

strength of light determines the degree of contraction of these muscles, and thus regulates the size of the pupil.

Immediately behind the iris is the lens, similar to that of the camera, which focuses the rays of light. It is superior to the glass lens of a camera, since it is automatically adjusted to the distance of the object. This adjustment is the work of a ring of tiny muscles attached to the lens of the eye. Its function is to allow the lens to bulge or thicken when the object seen is near. It is only when an object is near at hand that these tiny

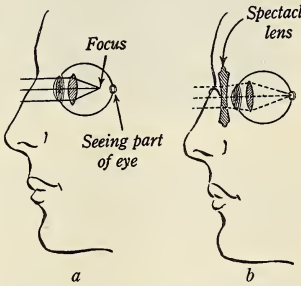
muscles are used. This means that when we are studying we are using these tiny muscles. Overuse of the eyes in close work, as you can see, is one of the causes of eyestrain.

241. The cause and correction of eye defects. If our eyes are of the right curvature, the rays of light will be focused directly and sharply on the retina in the rear of the eye. When the eyeball is too long, the image tends to come to a focus in front of the retina and is blurred; the object must be moved nearer, and we are said to be nearsighted. When the eyeball is too short, the image tends to form behind the retina, and the object must be moved farther away. Both of these conditions result in serious eyestrain if not corrected by eyeglasses. To correct for nearsightedness, lenses that spread the



TWO KINDS OF SPECTACLE LENSES

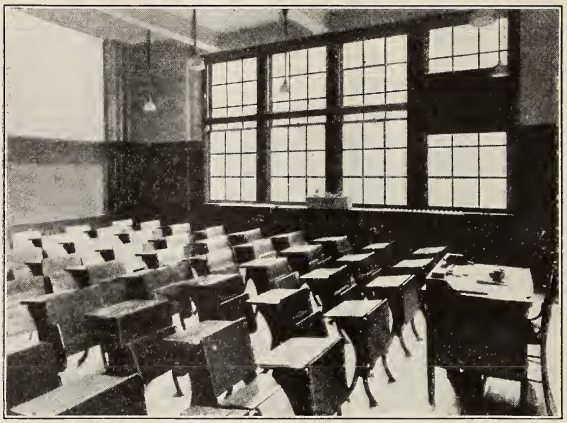
a, a concave lens spreads the rays of light; *b*, a convex lens narrows the rays of light. Which kind of lens is used for nearsightedness? for farsightedness?



GLASSES CORRECT DEFECTS OF VISION

This man is nearsighted. What kind of spectacle lens is he using? How does it correct the defect? Draw two pictures, similar to these, illustrating farsightedness and its correction by means of glasses. Explain to the class

rays a little are used, so that they do not focus so soon. For farsightedness, glasses are needed that bring the rays of light together a little more than the lens does. If the lens or the front of the eyeball is irregular in shape, the rays are confused on the retina. Such a defect is called astigmatism.



A WELL-LIGHTED CLASSROOM

Note the double shade rollers placed at the middle of the windows. This permits the shading of either the upper or the lower part of the window independently. Do you help to adjust the shades in your room?
(By courtesy of the Eye Sight Conservation Council of America)

242. The lighting of buildings. The problem of lighting has become one of the principal problems of architecture. The lighting must be adapted to the work to be performed in the room. Schools in the city, where land is too expensive for ground-floor buildings, are being built with windows on only one side of each room. It is better to have it come on the left side, so as to avoid shadows

when one is writing. Window shades should be conscientiously adjusted to the changing light during the day. Many busy teachers appoint a responsible committee of pupils to look after this adjustment. Nothing is more important. The light which comes from the top of the window is most desirable. Some shades may be adjusted from the top. Homes often have too many shade trees close by. This makes the interiors dark, gloomy, and not favorable to the use of the eyes.

243. Take good care of your eyes. Your eyes, like any other kind of delicate machinery, will wear out if they are not properly cared for. If you subject them to great strain, either through overwork or because of a lack of glasses, you will suffer from fatigue, nervousness, headache, and other handicaps. Your nervous system will function poorly.

The New York State Department of Education feels that the care of the eyes is so important that it is distributing a printed sheet of directions for the care of the eyes. This sheet is intended to be pasted on the inside covers of textbooks. It reads as follows:

RULES FOR CARE AND USE OF THE EYES

While reading let plenty of light, from the left, shine on your book. If left-handed, let the light shine from the right while writing.

Dim light and glaring light make the eyes tired and weak. Use light that is agreeable to the eyes.

Avoid fine print, blurred letters, and shiny paper; they are sure to strain the eyes.

Sit erect and place your book or paper about 12 or 15 inches from the eyes.

Be sure to consult your doctor if you have headache, dizziness, or a tired feeling; they may come from eyestrain.

Rest your eyes when they are tired. Do not strain them.
Let the doctor treat your eyes. You cannot do it yourself.
If the doctor tells you to wear glasses, wear them.

Can you add anything else to this list?

Review and Thought Questions

1. How does the nervous system resemble a telephone system?
2. What are the chief organs of the central nervous system?
3. What is the work of each organ?
4. How does alcohol affect self-control?
5. What nerves lead from the sense organs?
6. What nerves lead to the muscles?
7. What is a synapse? What is its work?
8. What law of learning is involved in the mastery of the piano?
9. What law of learning is involved in liking ice cream after the first taste?
10. How may we develop traits of character like courage in telling the truth?
11. What is there in the nervous system which corresponds to the transmitter in the telephone system? Name each of them.
12. How are smell and taste related?
13. How many different sensations do we get from the skin? What is the value of each?
14. What is the value of the sense of pain? How should we try to meet pain? Why?
15. What are the organs of internal sensation? What is the work of each?
16. Describe how we hear.
17. How can we take care of our hearing?
18. Describe the eye and the way we see.

19. What are some of the common defects of the eye? Describe their cause.

20. How can we take care of the eyes?

21. How may buildings best be lighted?

Interesting Things to Do

1. Make a study of the nervous system of a starfish, earthworm, or insect. Use drawings and explain to the class.

2. Find more facts about the life of Helen Keller, especially about the way in which she learned.

3. Read pages 352–354 in the Appendix, then try to test the sight and hearing of your classmates.

4. Make a list of desirable traits of personality. Train yourself in the mastery of at least one of these.

5. Read the lives of Washington, Lincoln, and Roosevelt. How did they build their personality?

CHAPTER XIX

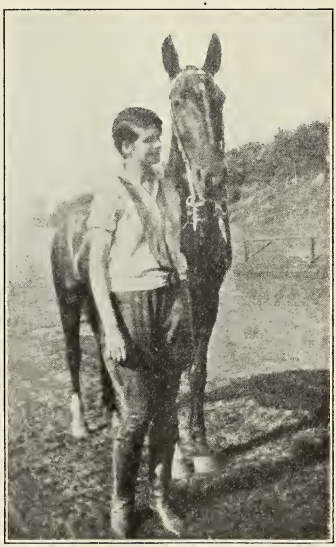
MENTAL HEALTH AND HOW TO GET IT

244. The meaning of mental health. When the word "health" is mentioned, we are likely to think at once of things that concern the mere physical body. Probably this word suggests to you at once good lungs, a strong heart, a keen appetite for food, gain in weight, freedom from illness, etc. Every citizen should aim to have a body that is as nearly perfect and as beautiful as possible; but if we could satisfy such an ambition, it would not necessarily mean that we should be happy. Happiness results not simply from good physical health but from being able to meet with fair success the problems that one has to face. Let us suppose that you have tried to do something and failed, and that you fail every day until you do not expect to be successful. You begin to feel discouraged and wonder whether it is worth while to try. At last you may give up in despair. Under such circumstances, even if you do have a good heart, a good digestion, and excellent lungs, you are mentally sick.

Being in good mental health means that one is fairly successful in getting along with others and in doing things that he sets out to do. He feels a keen interest in life. It seems satisfying and worth while. He is a happy individual.

245. Mental health must be earned. Good mental health does not drop from the skies. It is not the special possession of the rich or the poor, or of a particular race or

class. Every human being has difficulties in life. Everybody must learn how to meet these in the proper way if they are to be mentally healthy. For example, a failure may be turned into a success because one learns from it. One scientist in a laboratory tried hundreds of experiments over a period of seven years before he was successful. Each experiment taught him something. He improved his methods. He discovered some of the reasons for his failures. At last he won success. He had not allowed himself to become sour over his failures. He had made each one a stepping-stone to success. To resolve to profit from our errors is an attitude that will be serviceable to us in learning to be mentally healthy. It is not easy to learn, but it pays a high rate of interest to those who master this lesson.



LET US GO FOR A RIDE!

Horseback riding is an exhilarating sport

246. Study your strong and your weak points. In addition to studying our lessons in school we should study ourselves diligently to find out what we can do best. One reason why we fail and often suffer keenly is because we attempt that which for us may be impossible. Some of

our friends or acquaintances make the football team or get on the honor roll. We fancy we can do the same thing, but we meet with defeat. It may be worth while for us to keep on trying, or it may be much better for us to try something else. It is well to remember that no two people are exactly alike. Some are born with good voices, and it is an easy matter for them to sing; others may have little in the way of natural talents, and so can make little progress. It is foolish to think we can do everything that anybody else can. When we find that we cannot do a certain thing, it is better not to lament about it but to turn to something that we can do. If we cannot sing, or make the team, or get on the honor roll, we may improve our school work, paint pictures, develop skill in writing, or make a flower garden.

247. Keep yourself in good physical health. One's mental health depends to a very great extent on one's physical health. The boy or girl who gets plenty of sleep, eats nutritious food, gets plenty of recreation in the open air, and practices all the rules of healthful living is more likely to start the day's work with vigor and interest. Success is more likely to result. Buoyancy and a feeling of confidence naturally follow a good physical condition.

248. Seek wholesome recreation. It is impossible to keep mentally fit if we apply ourselves constantly to our work. Everybody needs to get some recreation every day. It should be so fascinating that study, school, and work may be forgotten. As far as possible this recreation should be taken out of doors. Outdoor games, hiking, mountain-climbing, rowing, swimming, bird study, and photography are all delightful forms of recreation.

249. Avoid excusing yourself for your failures. We naturally try to avoid pain. When we are not successful, it

eases our mind somewhat to excuse ourselves. If we do not win the game, it is so easy to say: "I have had less experience in playing. I am younger. I am not feeling well." At times these excuses may be real reasons, but often they are only means whereby we make ourselves more comfortable. Perhaps the real reason why we were

A PHYSICAL EXAMINATION

The doctor helps the boy scouts in camp to be healthy and happy

beaten is because we were matched with superior skill. Recognizing that this is the real reason may help us to improve, because we shall probably watch ourselves and the game carefully and strive for improvement. Some people rather pride themselves on evading their fares on a street car. They are people who are usually honest. When asked about it, they can furnish many excuses, which are not true but which give some kind of mental relief. They may repeat these excuses so frequently that

they finally begin to believe them. Among the excuses given for not paying a fare are the following: "The conductor did not ask me for the fare." "The street car company is rich and does not need the money." "I ride so much on this line that I am entitled to a free ride now and then." Giving such excuses does not help one to do the right thing next time. Examine the excuses that you are tempted to make. Learn to face the facts, even if they are disagreeable.

250. Avoid blaming people or circumstances for your failures. This is another bad habit. If somebody beats us in a game, we are likely to say to ourselves, "My opponent cheated," or "My croquet ball was chipped." One of these reasons may be the correct one, but in most cases our thought simply tries to make us more comfortable. Such thinking does not help us to play the game better next time. It may become habitual, so that we annoy other people by our faultfinding. Finally we are not a welcome member of any party. Suppose that the real reason is that we play a poorer game. If, instead of spending time and energy in faultfinding, we set ourselves the aim of finding out our mistakes and correcting them, we shall improve in our power to play the game. It is a good habit to face the facts courageously, with determination to do better next time.

251. Good thinking about sour grapes. When we cannot get a thing, we are likely to make ourselves feel comfortable by saying that it was no good anyway. We should remember the fable about the fox who saw some very attractive grapes. He made every effort to get them, but when he found that this was impossible, he preserved his pride by saying that they were sour. People who lose their jobs through inefficiency are prone to say that they

did not care much about them. Those who are poor often say that money is the root of all evil. The boy or girl who cannot get the prize may say that it doesn't amount to much after all. This way of looking at things is not helpful. It may get to be a bad habit. It would be much better to say that the prize is worth while, and either to admit frankly that it is beyond us or to make a fresh effort to succeed in a similar enterprise next time. If the fox had been honest with himself, he might have thought that they were good grapes and tried to find others like them within his reach. If he really believed that they were sour, he might have searched elsewhere for sweeter ones.

252. Refuse to bear grudges against anybody. Everybody is sensitive to praise and blame. We are naturally hurt by what other people say about us or by things that they do. We tend to feel bitter toward them and to carry this bitterness. If this becomes a habit, we suffer as a result. We are constantly imagining insults and slights, and we find it hard to get along with others. Peace of mind is denied us.

To overcome this bad habit it is well to remember that many of the things that are said are not intended to cut us at all; they are said thoughtlessly; and even when people intend to injure us, we can often overcome our bitter feeling by treating them as if nothing unpleasant had ever happened. If we can do that, we shall develop a stronger character.

Abraham Lincoln was a master mind and soul in living above grudges. When he was first elected to the presidency of the United States, he was regarded by many prominent people in his political party as uncouth and unfitted for this high position. Many unkind things were

said about him by men who had tried to get the same office. This must have hurt Lincoln, but when he became president he laid aside any feelings that he might have had, and chose some of these same men for his cabinet. He chose them because he believed they were the best men that the country could have. This ability on the

GARDENING IS A WHOLESOME AND PROFITABLE HOBBY

part of Lincoln to ignore personal grievances was shown again and again throughout his life. Once General McClellan, who was in command of the Union troops, was very discourteous to Lincoln. A member of the cabinet became furious and advised the President to remove him from his command immediately. But Lincoln, who still believed in McClellan, smiled sadly and said, "I will hold McClellan's horse if he will only bring us victories."

253. Carry your dreams into action. It's great fun to daydream. We can readily change our world as if by

magic. We can become wealthy, powerful, handsome, clever, and talented in a moment. Daydreams charm and rest us. Moderate daydreaming may be restful and helpful, but daydreaming may become a bad habit. We should not be content even with fascinating daydreams, but should try to make them work. Try to guide your dreams in a practical way. It is a good thing, perhaps, to dream about yourself as a great musician, but skill in music comes through long-continued, strenuous practice. Do not let your dreams take the place of rigorous self-discipline. Spend less time in dreaming about what you would like to be, and more time in trying to become what you wish.

254. Conquer worry. Fear is the cause of worrying. We never worry when we feel that everything is coming out all right. Worrying is a bad habit. It makes us very unhappy, and it interferes with our work. There are several different things that we can do if we tend to worry. First, we may remember that the thing which we fear seldom happens. Again, we may turn our thought toward something else; if we worry about our lessons, we may turn our attention to some good book or other form of recreation. But better than either of these remedies is action, if action will help. If there is anything that can and ought to be done, then we should do it; if nothing can be done to meet the situation, then we should try to forget it. If we are preparing for an examination, it will do no good to worry. We should do our best and then try to be satisfied. The person who cannot learn to be satisfied with his best is likely to have a nervous breakdown.

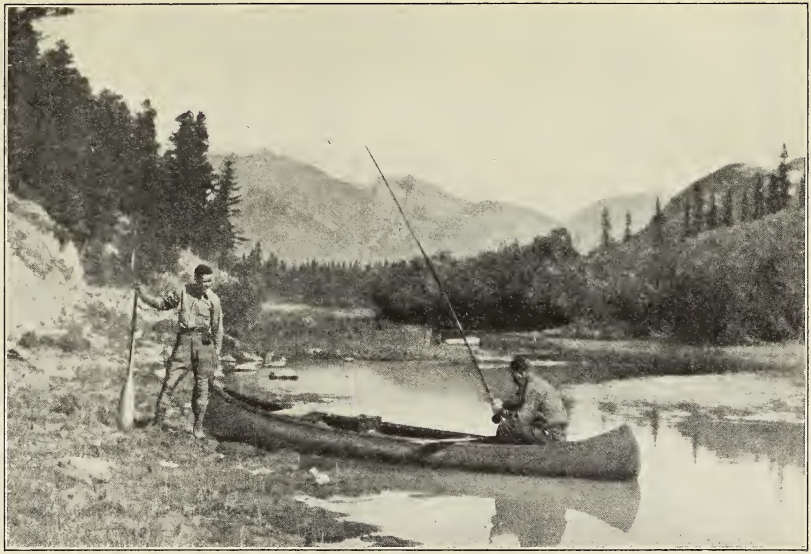
255. Do one thing at a time. It is a bad habit to allow your mind to wander when you are trying to do something. It often leaves one with a sense of things half

done. No matter how many things are pressing in upon you to be done now, choose the most important and bend all your energies toward that. We can get concentration of attention only by practicing it. Before starting any work it is a good plan to arrange everything so as to make for concentration. For example, if you wish to study your arithmetic for the next half hour, it would be a good plan to clear your desk of all papers and books that are unnecessary in getting your arithmetic lesson. Remove all distractions, so far as possible. Then launch yourself into your work with the determination to stick to it until you succeed. Sometimes this takes courage, but if you persist, you will have the satisfaction of having succeeded. Getting the habit of complete concentration on your task will make you happier and more successful.

256. Seek inspiring influences. To keep healthy mentally it is well worth while to seek the companionship of beautiful music, inspiring books, and wholesome friends. By learning to love the best in music and art we gain an interest that helps to make life sweeter and better.

257. Learn to rely on yourself. Many boys and girls get into the habit of depending upon their fathers, mothers, and teachers more than they should. While a certain amount of this may be necessary in early life, self-reliance should be steadily gained if one is to meet the world with success. The way to become self-reliant is to *practice* self-reliance. Plan projects and carry them through yourself, seeking as little help as possible.

258. Mental health comes through practice. Good habits determine good mental health. As we learn to conquer worry, to be honest with ourselves, to meet every problem that comes up honestly, to do our best and be content with our best, to carry out our dreams into action, to be



ROUGHING IT IN THE WILDS DEVELOPS SELF-RELIANCE

Why? Tell about other ways of developing this trait of character

self-reliant, etc., our mental health will improve. Mental health, like physical health, does not ordinarily come without effort. It must be earned by patience, perseverance, and practice.

Try This

After reading each of the following statements write a short sentence that will tell the best reason why you think each is true. Let the members of the class compare sentences. Which is the best?

1. One may be in good physical health and still not be healthy.

2. Mental health is as necessary as physical health.

3. The test of mental health is happy, successful living.

4. Mental health depends on our forming the right kind of habits.

5. To be successful one should learn to know one's self.

6. Keeping one's self physically fit is a step toward mental health.

7. Excusing one's self for failure is a bad habit.

8. Instead of excusing ourselves for failure, we should look for the causes and try to remedy them.

9. Abraham Lincoln practiced some of the laws of mental health.

10. Daydreaming may be a vicious habit.

11. Self-reliance is a good mental habit.

Interesting Things to Do

1. In your reading of the lives of great men and women, look for examples of good mental health.

2. Write a list of good mental habits that you have acquired. Explain why they are desirable habits.

CHAPTER XX

SCIENCE CONDEMNS DRUG HABITS

259. In the grip of habits. We are what we are because of the habits that we form. This relates to everything that we do. Neatness in dress, accuracy in mathematics, good posture, telling the truth, and self-reliance, all become matters of habit. After we have practiced them for a long time we dress neatly, stand tall, and tell the truth without thinking. Finally we are quite firmly in the grip of habits which we can change only with the greatest amount of effort. This is true of all habits, whether they are good or bad. One may get in the grip of a bad habit as well as of a good one. Thus we see how important it is to have good habits as our friends. Every good habit is like money in the bank. It is a real help in time of need. Good habits help us to be happy and efficient men and women, — to be successful in life. Bad habits enslave us.

260. Alcohol habits in history. Centuries ago, at the very dawn of history, people were using drugs. Chief among these were alcoholic drinks. The early Egyptians left pictures which show men making wine from grapes, and beer from barley. They also show bands of young people leaving the drink shops at night, carousing and breaking into the houses of peaceable citizens. Even at that early day the danger from alcoholic habits was recognized. Writing tablets found among the Egyptian ruins give warning against drunkenness. "Do not waste your time in the beer

house," one father wrote to his son. "How easily you might fall and break your limbs where no one would be near to help you." The Greeks and Romans have left us in their literature vivid accounts of revelries and drunkenness.

261. General recognition of drink evils. Even before the dawn of science the evils of drink were recognized, and measures were taken to correct them by law and punishment. As early as 1129 B.C. drinking companies were threatened with death by a Chinese ruler. In India, in 900 B.C., a law was passed punishing merchants and sailors for drinking. They were to be branded with a red-hot iron, and it was commanded that nobody associate with them. The laws of ancient Athens condemned to death any member of the Areopagus who became intoxicated. In their sacred book, the Koran, the Mohammedans forbid the drinking of alcohol. Among the Mohammedans alcohol carries the name of "mother of vices." It is not considered as a legitimate article of commerce by them, since legally they have no right to produce, consume, buy, sell, or transport alcoholic liquors. Laws against drunkenness have been passed generally among civilized peoples. Most of the great nations have attempted to control drinking by some kind of legislation. The most striking attempt at control occurred during the World War. It was then recognized by the great powers that one way to help win the war was to prevent drinking. As a result strict laws were passed and enforced. Although the manufacture and sale of alcoholic liquors is again legal, all students of hygiene are agreed that the alcoholic habit must be carefully avoided.

In the following pages the general attitude of science toward alcohol and other drugs will be briefly presented.

262. Alcohol is a drug. Some of the advocates of the use of alcohol have defended their stand by attempting to show that alcohol is a food. Even if this were admitted on its face value, it would be an absurd defense. It is true that some scientists, like Atwater, report that alcohol appeared to be burned in the body like fuel foods, and in that sense it might technically be called a food. But these same scientists gave explicit warning as to the danger of alcohol, and that the total effect was to be considered. Scientists are agreed that the food value of fruits and grains used in the manufacture of alcohol is largely destroyed in the process of manufacturing, because their starch and sugar are largely changed to alcohol. Then, too, good foods, like oatmeal, milk, and oranges, not only supply energy but help to build muscle and bone. Alcohol does not build any body tissue or repair waste. We have absolutely no evidence to show that alcohol can supply anything but energy; and while it may do this, it has a poisonous effect on the body. Medical and health authorities also, with few exceptions, agree in the belief that alcohol is a drug and is in the same class with opium and morphine.

263. Alcohol as medicine being dropped. There was a time within the memory of those now living when alcohol was thought to be very valuable as a medicine. It was used liberally by physicians for colds, snake bites, tuberculosis, typhoid fever, and other maladies. But the practice of medicine has changed so that its use has been greatly reduced. Some physicians never prescribe it. Its use in hospitals, even before prohibition, was limited. Physicians have found safer and better remedies. In 1917 the House of Delegates of the American Medical Association, the largest association of the physicians of

America, adopted these resolutions: "The use of alcohol in medicine as a tonic, a stimulant, or for food has no scientific value and should be discouraged."

There is a large number of physicians who hold opinions similar to those expressed by Dr. William A. Evans, formerly health commissioner of Chicago, who has said:

> Forty years ago, when I became a member of the medical profession, alcohol was in considerable vogue as a remedy for consumption. A great many people with consumption were fed alcohol in large quantities as a means of prevention. I have seen some people who were treated for consumption with alcohol. I never saw anybody who was cured by that treatment. I have seen it lead a lot of people into drunkenness. I have never known one person to be cured of consumption by the taking of alcohol. I don't believe there is anybody who at the present time claims that alcohol is a cure for consumption.

Alcohol was once thought to be a cure for blood poisoning, but Dr. Evans asserts that there is absolutely no scientific basis for such a belief. As to snake bite, he also asserts his belief that death from snake bites will probably decline with the diminished use of alcohol. In summing up his belief in regard to alcoholic drinks and disease Dr. Evans asserts that alcoholic stimulants "are without value."

264. Alcohol a foe of athletics. The evil effects of alcohol on athletic games and contests are so well known that its use, at least during training, has been forbidden by coaches and athletic associations. When a star athlete begins to drink, his days of superiority are numbered.

Amos Alonzo Stagg, the famous coach at The University of Chicago, said, "As a coach I do not believe, and none of the coaches that train men believe, in the use of alcoholic

drinks." When the Olympic team which Coach Stagg helped to train went across to Paris to play, they even took their own water with them, to which they were accustomed. "Now," said Stagg, "American athletes stand up at the top; there are none better; and the only ones that approximated us at all were the Finnish athletes, and they do not use liquor. So there is not any question about the fact that the use of liquors in training is a detriment."

AMOS ALONZO STAGG

Famous athletic coach who advises athletes to avoid alcohol if they wish to succeed

265. The alcohol habit wasteful. All the time, money, and effort spent on alcohol are a waste. The same amount of effort invested in an industry like farming or manufacturing, or in schools, libraries, or roads, would be a blessing to mankind. The train of evils that follow the use of alcohol brand it as a positive injury to mankind.

In days gone by it was very common for people to drink wine and serve it to their guests in much the same way as tea is served today. The drinking of alcohol was almost universal. The great American author Ralph Waldo Emerson lived during this time. With his keen mind he saw what a wasteful personal habit it was. In one of his

journals, written almost a hundred years ago, there appears this interesting comment:

> This year I have spent say $20 in wine and liquors which are drunk up, and the drinkers are the worse. It would have bought a beautiful print that would have pleased for a century; or have paid a debt. . . .

Drink is one of the chief causes of poverty. The reason is a double one: it reduces earning power and wastes much of what is earned. One way of getting at the facts is to study the demands made upon charity organizations for help. In one study in Boston during the days of the saloon it was discovered that in the case of 352 able-bodied men who in one year failed to support their families, 243, or 69 per cent, were drunkards.

Evangeline Booth, Commander of the Salvation Army, says that during saloon days 50 per cent of the cases that came to them for relief were drink addicts.

266. Drink habit a handicap to business. Even those who use alcohol prefer to hire, in their business, people who are not addicted to its use. Among the advertisements frequently appearing in the daily papers during saloon days were those calling for a barkeeper. Not infrequently among the qualifications named as requisite for the position it was stipulated that the applicant must not be a drinker. Even the saloon-keeper did not care to have a drinking man handle his money and look after his business. This attitude on the part of the saloon-keeper was shared by other business men. Railroads, banks, department stores, and many other business organizations would not hire men who drank, particularly those who drank during their hours of employment. Today the habitual drinker stands little chance to be successful.

267. Number of accidents increased by alcohol. Many experiments with alcohol show that its use dulls the caution of the workman and makes his movements less certain. It is not surprising, therefore, to find the large percentage of automobile accidents due to drinking. Who would care to ride in a taxicab with a driver who was under the influence of liquor?

In the shops where men are running rapid, high-powered machines, and where a slight mistake may endanger life or limb, there is the same risk. The loss from accidents in industries became so great that a National Safety Council of the United States was organized. In 1914 this organization had in its membership 1700 industries and over 2,500,000 workers. At that time this council adopted the following resolution:

Whereas, It is recognized that the drinking of alcoholics is productive of a heavy per cent of the accidents and diseases affecting the safety and efficiency of workingmen,

Be it resolved, That it is the sense of this organization that it go on record in favor of eliminating the use of intoxicants from the industries of the nation.

268. Even moderate drinking affects muscular control. The drinker who staggers and makes silly remarks has evidently lost his self-control. Both mind and muscle have lost their efficiency. Science shows that alcohol is readily absorbed into the blood, by which it is carried to the various cells of the body. It directly affects the higher centers of the nervous system, weakening judgment and self-control. Lack of control from this cause is responsible for many accidents and crimes.

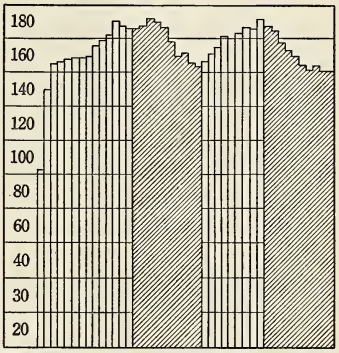
It should be made clear that even moderate drinking impairs muscular control. A very interesting experiment showing how the drinking of alcoholic liquors affects con-

trol was carried out by threading needles, — an operation which, like many other kinds of work, requires quickness and precision. The experimenter put 200 needles in a cushion and then placed many threads, cut about eight inches long, on a board where he could easily pick up the single threads. An accurate record was kept of how many were threaded for each period of five minutes. The graph on the opposite page shows what happened. The white columns show the amount of work done each day when he took no alcohol; the shaded columns show the work done on days when he took 25 cubic centimeters of alcohol. Notice how he gained in speed. The first group of the white columns shows how he increased the number of needles that he could thread in twenty minutes. The first day he threaded only 103; the second day, 150; the third day, 165. Finally he was able to thread 190. Three days later he began to take alcohol. There was a slight increase at first, and then a regular decrease until, on the twenty-fourth day, he threaded only 164 needles. During the last of these alcohol days he found his hand trembling and his eyes growing tired more easily. Notice how his skill returned when he stopped drinking alcohol.

There are many experiments showing that alcohol not only reduces the amount, but also the quality, of work. In almost every case the worker thinks that he can do more, but actual tests show that he tires more quickly or works less accurately.

Is it at all strange that none of us would care to have a dentist fill our teeth or a surgeon perform a delicate operation on us if he were known to use alcohol? The pilot on a boat and the engineer on a locomotive are not allowed to drink alcohol. For them and for others in their keeping alcohol spells danger or perhaps even death.

269. Alcohol shortens life. The best information that we have about the effect of alcohol on the length of life comes from insurance companies. Just before national prohibition was adopted, forty-three American life-insurance companies undertook a study of their policyholders. In this study, among other things, the death rate among users of alcohol and those engaged in the liquor trade was examined. Only those who were in good physical condition when insured were included.



DRINKING ALCOHOL LESSENS SKILL

The columns in white show the number of needles threaded when no alcohol was taken. The shaded columns indicate needles threaded on alcohol days

The study showed that generally the drinkers died earlier than the average insured man. Those who had occasionally "gone on a spree" in the period before insuring had a death rate 50 per cent higher than the average. That means that, where we should have expected 100 to die, there were 150 deaths. Among those who, when they were insured, said that they drank every day two glasses of beer, or a glass of whisky, or some other liquor containing alcohol, the death rate was 118 against an average of 100. Among those who drank every day more than this amount the death rate was almost double what it should have been. They lost 186 when they should have lost only 100. The cause of death was varied,

but there was an abnormal amount of Bright's disease, pneumonia, suicide, and cirrhosis of the liver. In the class of moderate drinkers there were five times as many cases of cirrhosis of the liver as among average insured men.

The insurance records showed that the men engaged in making and selling alcoholic liquors were in a business carrying a special health risk. Among brewery foremen, for example, the death rate was higher than among men engaged in dangerous occupations, — for example, electric linemen and city firemen. "The general trend is the same in all companies," says Dr. E. L. Fisk, "and shows that Old Mortality and John Barleycorn are exceedingly good cronies. Wherever you find alcohol you find the following formula at work: More alcohol, higher death rate."

270. Alcohol increases danger from cold. Many people believe that alcohol produces warmth and consequently protects against cold and exposure. This is an old notion that we must let go. Long ago experimenters proved that the use of alcohol leads to loss of bodily heat and increases danger from the cold. What happens is this: Alcohol paralyzes the nerves which control the size of the blood vessels near the surface of the body. This permits an extra amount of blood to flow to the surface of the body. The little sense organs in the skin report this to the brain and a feeling of warmth is recorded. But when the blood is brought to the surface in this way it is chilled by the colder air of the atmosphere. This leads the body to lose heat just at the time when it is most needed. Soon the drinker feels colder than before, if he is not so overcome by cold as to be unconscious. This is the reason why the drinker, when exposed to the cold, is more likely to freeze. Great arctic explorers like Nansen find no use for alcohol

as a protection against cold. Anyone who wishes protection would do well to spend his money for warm clothing, hot food, and hot drinks rather than to use alcohol.

271. The grip of the alcohol habit. The peculiar thing about alcohol is its tendency to produce a desire for increasing amounts. It is not a true food, and there is no natural need for it, but in the case of very many who begin to drink alcohol the desire for it becomes so strong that it may be difficult if not impossible for them to shake themselves free from its clutches. This is not true of milk or of any real food. Although after using milk for a long time one would miss it, there would be no abnormal craving for it that would make it difficult to drop it out of the diet.

Some people say, "I can drink liquor or leave it alone." This may be true of some people, or at least for a time and under favorable circumstances, but there are many others, often people of marked ability or even genius, over whom alcohol sooner or later obtains a mastery. No one knows in advance whether he is susceptible to its enslaving power or not. The number of those who are is so large that in every country where alcohol-drinking customs and the liquor traffic prevail the evils of alcoholism become a troublesome social problem. To take the first drink is like playing with fire; it is gambling with accident, disgrace, and perhaps with death. The only safe thing to do is to leave it alone. Moderate drinking is the starting point for immoderate drinking.

272. Tobacco contains poison. Before the middle of the sixteenth century the use of tobacco was confined solely to the American Indians. At first tobacco was cultivated in Europe as an ornamental plant. Gradually its use for smoking, chewing, and snuff spread to all parts of the world.

Studies by scientists show that tobacco contains a powerful narcotic poison called nicotine. There is a wide difference of opinion among users of tobacco as to its effect, but there seems to be no evidence that a sound, healthy person who has not formed the tobacco habit can do better mental or physical work by using it. The evidence shows that the use of tobacco tends to cause rapid heart action, shortness of breath, and palpitation of the heart. Physicians sometimes refer to certain abnormal conditions of the heart as tobacco heart. Tobacco heart sometimes causes death when the smoker is put under severe physical strain or when there is an acute disease like typhoid or pneumonia. Surgeons sometimes notice that tobacco-users fail to rally after an operation as a non-user would under like conditions. The free use of tobacco sometimes causes increased blood pressure, sleeplessness, and irritation of the nose and throat.

Only one insurance company has published its experience on tobacco-users. The New England Mutual made a study covering 180,000 policyholders for a period of sixty years. This study shows that those who did not use tobacco had a lower death rate.

In spite of the enthusiastic comments of some tobacco-users there is no evidence that the use of this drug ever advances healthful living. Everybody agrees that when used to excess tobacco is a vicious drug.

273. Tobacco injurious to young people. There may be a difference of opinion as to the effects of tobacco on adults, but there is general agreement that its use is dangerous to children and young people. There are at least four reasons for this agreement.

First of all, youth is the time for growth. There is a general belief that tobacco interferes with physical de-

velopment. Dr. Boas, in his study of 45,151 boys, found that those who smoked were, on the average, 1.13 inches shorter than they should be for their age, and the nonsmokers were 2 inches taller than the average. In weight the difference was 7.1 pounds in favor of the nonsmokers. Since tobacco is a narcotic and not a food, this is what might be expected.

Second, tobacco, like alcohol, is habit-forming. Some find it impossible to break the habit, or, if they do, they experience real distress. Many people become so addicted to the use of tobacco that if they cannot get it they are very irritable and unhappy. Some cigarette-users become so nervous and uneasy that when in a social group where smoking is forbidden they feel compelled to excuse themselves. At that point the craving for tobacco has become stronger than mind or will power.

Third, most young people cannot afford to spend their money for such a luxury. Often they feel that they do not have enough money to spend. They should be saving to get more education or to start in business. The wise youth will spend money where it will count most.

Fourth, there is little doubt that tobacco affects scholarship and skill. Professor Frederick J. Pack studied the scholarship of university men, in six different institutions, who tried to make the football team. This is what he found:

1. Only half as many smokers as nonsmokers are successful in the "try-outs" for football squads.
2. In the case of able-bodied men, smoking is associated with loss of lung capacity amounting to approximately 10 per cent.
3. Smoking is invariably associated with low scholarship.

It is true that some people use tobacco freely with little or no apparent bad effect. Probably they are born with

less susceptibility to the drug. No one knows beforehand how susceptible he is. The wise youth will weigh the known dangers of the tobacco habit before making himself liable to them.

274. Opium and other narcotics. Opium, cocaine, and heroin are among the most vicious of habit-forming drugs. Their use leads very quickly to a drug habit which it is almost impossible to break. People who form these habits have become their slaves. Not only do the drugs undermine and ruin the physical health, but they weaken the mind. Users of these drugs will sometimes commit crime to get them. Fortunately these drugs are not so widely used in this country as are alcohol and tobacco.

The opium habit especially has been associated with China. It so undermined the mental and physical welfare of the people that the Chinese tried unsuccessfully to protect themselves by preventing foreign traders from importing it. This led, many years ago, to the Opium War. The Chinese lost and were unable to get rid of the horrible traffic, which was a disgrace to Christian civilization. Recently great international conferences have been held to try to regulate or stop the traffic. Even in our own country there is a vast quantity consumed that is not needed for medicinal purposes.

It is never safe to take a drug suggested or offered by a stranger or to experiment with narcotic drugs.

275. Patent medicines. There are a great many medicines on the market today known as patent medicines. Most of them are highly advertised and claim that they can cure almost any kind of disease, including such maladies as consumption, Bright's disease, and cancer. Many of these medicines are manufactured by people who know little or nothing about medicine and are not honest

in their claims. Such medicines sometimes contain habit-forming drugs, but most of them are useless if not dangerous. Patent medicines should be avoided. When one is ill the best thing to do is to go to a good physician. It is a bad habit to be continually taking drugs without consulting a doctor. The patent-medicine habit may become as persistent as the alcohol or tobacco habit.

276. Rely on good health habits. There are no short cuts to health. The way to be healthy is to take the best medical advice and to form good health habits, such as getting plenty of sleep, drinking milk, eating vegetables and fruit, and living as much as possible in the open air.

Questions for Class Discussion

1. In what way are we in the grip of habits?

2. What evidence have we that alcohol was a problem centuries ago?

3. What is a drug? Why is alcohol a drug? a narcotic?

4. What is the danger in using alcohol as a medicine?

5. Why is it better, when you are ill, to consult a physician than to try to doctor yourself?

6. Do athletes use alcohol and tobacco when in training? Explain.

7. How is the use of alcohol related to poverty? to business?

8. Why do you think it would be undesirable for an aviator to use alcohol even moderately?

9. How does alcohol differ from food in its effect?

10. Why is the use of alcohol and tobacco especially undesirable for young people?

11. What other drug habits are especially dangerous?

12. What are patent medicines? Should you recommend their use? Explain.

Interesting Things to Do

1. Interview several successful business and professional men as to whether, in their judgment, it would be wise for students in the junior high school to use alcohol and tobacco.

2. Write to the American Medical Association, 535 North Dearborn Street, Chicago, for printed matter on patent medicine. Give a ten-minute report to the class.

3. Prepare a five-minute speech for the discussion of the proposition that everybody should obey the law, whether he believes in it or not. If he does not believe it is wise or just, he should still obey it but should try to get it changed.

CHAPTER XXI

LOOKING FORWARD TO YOUR LIFE WORK

277. Vocation and health. Some of you are beginning to think about what you will do after you leave school. What trade, business, or profession shall you follow? This is an important question. It is so important that if you do not make the right choice you may be unsuccessful and unhappy all your life. Before you reach your decision many things must be considered. Probably you will think first of the things that you like to do best, and of your own ambitions. The boy who dislikes tools would be foolish to decide to become a mechanical engineer, and the girl who dislikes to sew should not expect to be successful as a dressmaker. Besides thinking about his or her ambitions and natural abilities every boy or girl should consider every vocation from the point of view of health. These are some of the most important questions to be answered: Is this trade or profession conducive to good health? Is it dangerous or does it involve health hazards? Considering my own health, is there any reason why I should or should not look favorably upon this vocation as my life work?

One thing is quite evident: good health is being demanded more and more by professional schools and by industry. Many schools require the applicant to pass a health examination before admitting him. The following want advertisement indicates health as one of the qualifications:

TELEPHONE SELLING

One of Boston's fastest growing newspapers has a fine opening on its sales force for a wide-awake young woman to sell advertising over the phone. Must be capable, ambitious, and energetic, with a good command of English and real selling ability. Must have a strong, clear, convincing voice, *good health*, and an abundance of persistency, courage, and determination. The position pays a salary and commission and offers splendid opportunity for the right girl.

Some of the leading vocations open to young people will now be considered from the point of view of health.

278. Agriculture. This is one of the most important vocations. One third of our population live on farms. The other two thirds of the population depend on the farms for grain, meat, vegetables, cotton, wool, and other necessities of life.

Agriculture is one of the most healthful vocations. The working hours are spent almost entirely out of doors. There is an abundance of fresh air, sunshine, and exercise. Fresh fruit, vegetables, and milk are easily secured.

The natural hindrances to health are few, but unfortunately farmers do not always live in the best way to make use of their opportunities. Although they have exercise, some muscles are not used as much as they should be. In using machines the farmer often takes bad positions that result in poor posture. During the day he

may have plenty of fresh air, but his house may not be well ventilated. Investigations of the diet of people in rural communities show that white bread, meat, pork, molasses, and potatoes are too often the staple diet. Frequently there is a deficiency in green vegetables and fresh milk.

DIGGING POTATOES

Farming is healthful outdoor work

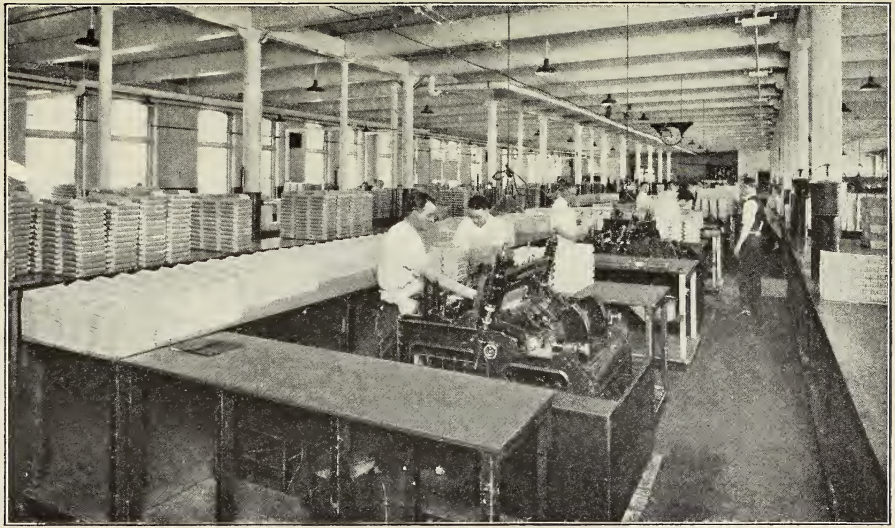
If one will follow the rules of healthful living, there is no vocation that offers such rewards in good health.

279. Mining and manufacturing. The vocation of mining furnishes fuel and much of the raw materials of commerce. In contrast to agriculture, mining is undertaken with risk. The miner must work in the dark and do heavy tasks. Fresh air, sunshine, and wholesome exercise are lacking to a great extent. Notwithstanding these handicaps, mining offers a future to a boy who gets good training and looks after his health. When he is not at work he should use every opportunity to get the air and sunshine.

Manufacturing includes some of our greatest industries. It involves the manipulation of machines. Most of the objects that we see are manufactured: alarm clocks, soap, bicycles, ships, boots and shoes, paper, lumber, and furniture. In a general way manufacturing involves the production and selling of goods. The salesman needs to practice little beyond the general rules of hygiene, but the operator of machines is exposed to special risks depending on the particular kind of industry in which he may be engaged. In certain manufacturing establishments dust is a great enemy of the worker. The metallic dusts, including emery, and marble dust are especially harmful. Chalk, coal, plaster of Paris, lime, and soot are less irritating, but over a long period of time the workers in these materials are likely to get a chronic inflammation of the lungs. In many factories the menace of dust is reduced or eliminated by the application of oil, water, or steam, which dampens the dust and prevents its rising. Exhaust devices in connection with machines often get rid of dust. In some industries there is danger from poisoning through contact with lead, arsenic, or mercury. A factory should be well ventilated, especially when poisonous gases are produced. The lighting should be adequate and seats should be conducive to good posture. Machines should be equipped with safety devices.

The health conditions in a factory should be as nearly ideal as possible. There should be individual drinking cups and towels, and opportunities to get wholesome food, rest, and recreation.

Anyone going into factory work should be satisfied with nothing less than good working conditions. If he has any particular physical weakness, a vocation should be chosen which is most likely to correct this defect.



A SANITARY FACTORY

Note its cleanliness and excellent lighting

280. Building trades. These trades employ a great army of workers, including carpenters, masons, plumbers, painters, decorators, electricians, and contractors. Much of their work is done in the open air and under conditions favorable to health. In nearly every branch of the building trades there is the possibility of falling from ladders or staging and of being injured while using tools. The workman needs to train himself in habits of carefulness and in simple first-aid treatment.

281. Transportation. This is another important vocation. Men who are engaged in operating railroads, street cars, ships, and busses are engaged in the occupation of transportation. Besides the workers, such as conductors, engineers, brakemen, and station agents, there are yardmen, telegraphers, towermen, and vast numbers of those doing clerical work in offices. Those who are engaged in office work, in common with all indoor workers, need to be careful about the ventilating of their working rooms, good posture, a well-balanced ration, out-of-door exercise, and recreation. The actual operating of a railroad is dangerous, — so dangerous that some insurance companies refuse to take risks on conductors, brakemen, firemen, and engineers. This means that for the safety of the worker and others who may be dependent upon him the workman needs to be carefully trained in safety. He should take good care of his health, particularly by getting enough sleep and avoiding the use of alcoholic beverages, so that he may always be keen and alert. Much of the operating work in transportation is so strenuous that it demands excellent health on the part of those who wish to enter this field.

282. Commercial occupations. Almost every occupation is commercial in the sense that it is concerned in some

way with the selling of goods or the selling of services, but the more distinctly commercial occupations include the work of salesmen, wholesalers, retailers, proprietors, commission merchants, stenographers, bankers, and advertisers. With the exception of the traveling salesmen nearly all these workers are sedentary. As we have already noticed, those engaged in sedentary occupations should be especially careful about getting recreation in the open air.

A TRAVELING SALESMAN

To be successful he needs to form good health habits

The commercial salesman runs the risk of accidents and infections because he is traveling constantly and because he eats and sleeps in such a variety of places. He needs especially to be careful concerning his personal safety in getting on and off trains and vehicles, and also to use his own toilet articles. One of the advantages of this occupation is that it is stimulating because of its great variety of contacts with people and scenes.

283. The learned professions. The learned professions are those which are usually thought of as requiring a college training and special work of an advanced character. In this field we find engineers, doctors, lawyers, dentists, pharmacists, teachers, librarians, journalists, and account-

ants. Since nearly all these professions require many years of strenuous preparation, those who wish to engage in them should consider very carefully their natural abilities, and whether their condition of health will permit such long-continued study. Good planning makes for success.

A REST AND RECREATION ROOM IN A LARGE FACTORY

Employers have found that their workers are happier and more efficient when they have such privileges

Many of the learned professions are sedentary and are subject to the dangers of all indoor occupations that we have noted before.

In the choice of one of these professions one should think of the chance, in that profession, of keeping in good health. For example, to be a doctor one should have a strong and vigorous physique. The practice of medicine is usually trying. Calls may come at any hour of the day or night; the doctor's meals and sleep may be quite

irregular, he has much responsibility, and he is under great strain. Such a profession requires abounding vitality and a naturally cheerful disposition.

284. Personal investigation of vocations. It is impossible, in this brief chapter, to consider any one vocation in detail from the point of view of health. There are necessarily many vocations that have not been mentioned by name. It is desirable that every boy or girl should make a personal investigation of two or three vocations in which he or she may be interested. Little has been written on health in relation to the choice of a trade or profession. One of the best ways to get reliable information about a vocation would be to interview people who are already engaged in it. Here is an outline which you might use in such an investigation:

Vocation: _____

THE PREPARATION

1. How many years of training are required?
2. Are there any special health risks involved in this training? If so, what are they, and how may the learner meet them successfully?
3. Is there anything in this training that is especially conducive to good health?

THE VOCATION

1. Does it involve indoor work? Does it involve outdoor work? State the proportion of each.
2. Is there any special liability to accidents? If so, what are they, and how may they best be avoided?
3. Are there any other special hazards involved? If so, what are they, and how may they be avoided?
4. To what extent is good health necessary in this vocation?

5. What defects in health might one have and yet carry on this vocation with success?
6. Have you any special suggestions as to keeping physically fit in this vocation?

If one wishes to enter some kind of industry, it will be a good plan to visit that industry and learn something about the working conditions.

Questions for Class Discussion

1. Have you decided upon what you will do after leaving the junior high school? If so, why shall you take that course rather than some other?

2. Have you decided upon the trade or profession that you will follow after leaving high school? If so, have you discovered that it has any health hazards? What precautions shall you take in following this trade or profession?

3. Describe the conditions to be found in a sanitary factory.

4. From the point of view of health, what are the advantages and disadvantages in farming?

5. What are the opportunities in mining and manufacturing? What precautions should workers in this field take to insure good health?

6. What are some of the trades and professions not mentioned in this chapter? What advantages and disadvantages does each one have in the way of healthful living?

7. Why should everybody give a good deal of care to the choice of a trade or profession?

Interesting Things to Do

1. Ask men and women representing various trades and professions to speak to your class on the advantages and disadvantages of their work.

2. Visit some factories and report to the class on the conditions.

3. Go to the library and try to get additional information on any trade or profession that you are seriously considering.

CHAPTER XXII

THE WIDE-AWAKE HEALTHFUL COMMUNITY

285. How we depend on one another. The onward progress of civilization has made us more and more dependent on one another.

Even the individual Indian was not independent of others. He depended upon other members of his tribe to join with him in the chase and to coöperate in waging wars of offense and defense. His language, customs, and religion were handed down to him by previous generations. Yet he and the members of his family provided in large measure for their food, clothing, weapons, and shelter. He roamed at will in his hunting and pitched his tent wherever he would, limited only by the customs of his tribe and the presence of his enemies.

In colonial times the colonists were remarkably independent. Although they tended to build their houses in settlements, so as to provide for defense against the Indians, and combined for religious, educational, commercial, and political purposes, each family had marked independence. They had little need of the corner grocery stores or other stores found in our village and city communities. Their sheep provided them with the wool which they spun and wove into garments, meat was a result of the hunt, fish were plentiful in the streams, the forest had an abundance of wood to feed the great fireplaces, and the cultivated fields offered grain and vegetables. The colonist lived in a house which he built himself, and most of

the crude furnishings were produced by his own efforts. Since then, at no time in the history of America has the individual citizen or family been so independent of other members of society.

How conditions have changed since the time of the Puritans! Think of your ordinary breakfast, and of the people in distant lands who have helped to add to your

COMFORTABLE HOMES — SIGNS OF A WIDE-AWAKE COMMUNITY

comfort. The wood of the chair you sit on may have come from a South American forest, and the linen on the table from Ireland. The flour used in your bread was made from wheat raised in a state a thousand miles away. The egg was provided by a farmer several miles away. The grapefruit came from Florida, California, or Porto Rico. It was purchased by a wholesale fruit dealer who in turn sold it to a smaller wholesale house which filled the order of your local grocer. Your mother ordered the grapefruit over a telephone which was made from Pennsylvania iron. At the close of the meal your newspaper

may be delivered by a neighbor's boy. How many people have been instrumental in gathering the news throughout the world! If you get interested in tracing things, you may even think of the thousands of people who were involved in the processes of making the two pennies which you use in paying for the paper. Our modern age, sometimes called the machine age, is an epoch of history marked by our dependence on others.

286. Good citizenship means service. The good citizen is one who helps the community. He not only shares with others the opportunities offered by his community, such as good streets, good schools, and good churches, but he does something himself to make the community a better place to live in. In that way he not only advances his own welfare, but also does something for the general welfare. It is easy to understand that the selfish person who thinks only about himself is a detriment to himself and his community. If he cares nothing about the men elected to office, about good schools, adequate playgrounds, and health, he will be so shortsighted as to injure himself and his community. In this chapter we shall discuss various questions relating to a healthful community. Many of these problems have been discussed in the preceding chapters, so that some of the chapter will be a review.

287. The good citizen looks after his own health. The person who is healthy is an asset to the community. He is able to do his daily work and does not become a menace or a burden to the community. When a man becomes ill from some contagious disease, he may start an epidemic. If he knows something about hygiene and is interested in his community, he and his family will obey the quarantine laws and protect other people if he unavoidably becomes ill. Sometimes, when the bread-earner of a family

becomes ill, they exhaust their savings, are unable to pay their taxes and bills, and may become public charges. Then everybody suffers. The sick man and his family suffer most of all, but the entire community loses. If every citizen looks after his own health and that of his family, the community will be a better place in which to live. Every member of a community may improve his health by observing the suggestions on personal hygiene referred to in the preceding chapters. Sleep, rest, recreation in the open air, eating nutritious food, and learning to meet one's problems in the right way are among these essentials.

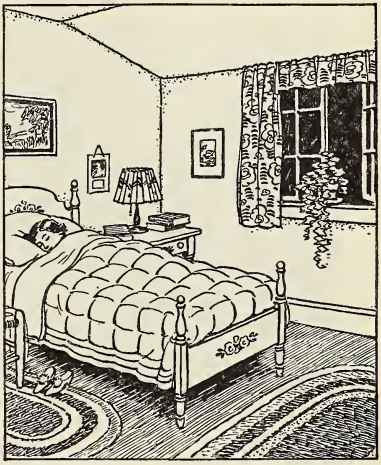
SERGEANT YORK

A hero of the World War. He is now interested in helping to promote the welfare of his community

More and more we are coming to realize that we need to make use of the doctor to help us to keep and improve our health. It is desirable for everybody to have a thorough physical examination once a year. In order that there may be a fixed time, so that the examination will not be forgotten, some departments of health suggest, "Have a health examination on your birthday." Such examinations may reveal slight defects or tendencies which, if cared for immediately, may prevent serious illness. Probably your school physician gives you

a physical examination every year. He is trying to help you to be healthier, but he can do this only if you follow his suggestions.

288. Healthful homes. The wide-awake community has homes that promote the health of the community. This means that people are not crowded into close and unsanitary quarters. There should be enough space so that there is plenty of air and sunshine. The windows should be adequate for lighting and ventilation. Overheating and underheating are both dangerous. The optimum temperature is about 68 degrees Fahrenheit. General cleanliness, *careful washing of dishes and rinsing with boiling hot water*, and careful disposal of wastes are desirable. Everything that can be done to add to the attractiveness of the home inside and out adds to the pleasures of home life and to mental health.



EXCELLENT VENTILATION IN A SLEEPING CHAMBER

Health habits need to be practiced even in a modern sanitary home

289. Wholesome recreation. Every up-to-date community provides the right kind of recreation for its citizens.

Work is important for well-being, but the opportunity for play and for recreation is necessary for community health. Parks, playgrounds, and bathing beaches provide recreation for young and old. Some cities even have theaters owned and controlled by the public. Besides the forms of free recreation offered by a community,

LOOKING OUT TO SEA FROM A PUBLIC PARK

Many parks offer a chance for rest and the enjoyment of nature. (Photograph by Ewing Galloway)

it should carefully supervise dance halls and theaters to protect boys and girls and the general public from evils that may arise. Every citizen, by his voice, pen, and personal influence, and by judicious voting for the right men to fill public office, may promote healthful recreation. No town or city is better morally than the citizens who live in it.

290. An efficient department of health. It is the business of a health department to protect a community against

epidemics and ill health and to promote positive good health. The experts in such a department should be well-trained men with sufficient funds and with freedom to carry out their ideas, so as to serve the community effectively. They are usually appointed to office by the mayor, with the advice and consent of a board or city

TOBOGGANING IN A PUBLIC PARK

Isn't it fun?

council. To have the right kind of men in a department of health the citizens need to be vigilant, to vote at every election, and to take pains at the primaries that the right sort of men are nominated for public office.

Dr. Louis Dublin says:

Less than 50 cents per capita probably represents the total [annual] expenditure of the American people for public health. The money spent for medical service is almost altogether for the care of disease, and not for its prevention. The relationship were better reversed. A new era of intensive public-health work must be brought about which will make available to the American

people the power of this new branch of science. The expert opinion of public-health officials indicates that an expenditure of $2.50 per capita, wisely directed through organized channels against preventable diseases and for public-health education, would reduce the annual death rate two points per thousand and correspondingly increase the expectation [of life] from five to seven years.

Does your community have enough money to serve its citizens efficiently?

291. The milk and water supplies. Both milk and water are so important in the diet, and also so frequently the means of carrying disease, that in both city and country it is necessary to take the utmost care to protect them from infection. For further information on this topic see Chapter VIII.

292. Wholesome food. In addition to milk and water the foods consumed by a community must be so controlled as to insure the general health. Some cities provide food inspectors whose business it is to examine foods and see that they come up to required standards of purity and freedom from infection. There are also state and Federal food inspectors.

The inspection of meat is a valuable service performed by our state and Federal governments. Care is taken that meat comes from animals that are free from disease, and that the slaughtering and preparation for shipment are carried out under sanitary conditions.

Even if food reaches the stores in good condition, it may be exposed to flies and vermin or may be handled directly by clerks and the general public. If every citizen refused to buy such food and gave his reasons to the merchants, such practices would soon disappear. In some cities there are laws forbidding the sale of bread which

is not covered with paper, and the exposure of any food to flies, dust, and hands.

293. Disposal of wastes. One of the marks of a progressive community is the prompt and efficient way in which

EVERY SELF-RESPECTING COMMUNITY TODAY RIDS ITSELF OF THIS MENACE TO HEALTH

Make a poster, similar to this, on the mosquito

it disposes of its wastes. In some places such wastes as ashes and garbage are disposed of by the individual citizen. Since so many people are too busy or too negligent to do this promptly, the homes, streets, and vacant lots of a town or city may become cluttered, unsightly, and even a menace to the public health. The better way

is to have the local government collect and dispose of such refuse. Ashes may be used to fill in low places, and garbage may be burned or fed to hogs.

The disposal of bodily wastes or human excrement is always a serious problem. In towns and cities provided with a sewerage system it is ordinarily a matter of little

LENDING A HAND

These boy scouts are coöperating with a woman's club during Clean-Up Week. Are you doing your bit for the community?

concern to the individual citizen. Sanitary plumbing from bathrooms easily solves the problem. Sewage from such sources is disposed of in various ways. Usually it is conveyed by huge pipes far out to sea or to some point in a body of water where it will not be dangerous to man.

In rural districts the disposal of such wastes is more difficult. The individual citizen must decide on the method to be used. Two precautions should be taken: (1) disease germs must not be allowed to reach the water

supply, and (2) bodily wastes must be screened from flies and other insects. The common pit privy, if far enough away from the water supply and well protected, may be satisfactory; but the septic tank or cesspool is better. By providing a water tank in the attic, country houses may have running water as an aid in sewage disposal.

294. Health in the school. The children of school age spend so many hours of the day in school that this time should be used to advantage in promoting positive health. School buildings should be properly lighted and heated; the furniture should be chosen and adjusted to encourage good posture; toilet facilities, and opportunity to wash the hands with hot water and soap, should be provided. The building might well contain a gymnasium, shower baths, and other modern conveniences.

Nearly every new school building erected today has grounds sufficient for outdoor sports.

Since the majority of homes in the community send children to school, the school may easily become a means of spreading contagious diseases. In our best schools the teachers are trained to recognize the symptoms of disease, and pupils with such symptoms are immediately referred to the school nurse and school physician. If they are ill, they are not allowed to come back to school until they have a health certificate from their family physician. It is a worthy ambition for every pupil to try to have perfect attendance, but it is a mistake to go to school when one is ill. It prevents speedy recovery, and it is not a kindness to others, who may catch the disease if it happens to be contagious.

Our best schools today train their pupils to live in a healthful way while at school. They keep clean, drink

from sanitary fountains, use individual towels, choose nutritious food in the lunch room, avoid coughing in one another's faces, help the teacher in ventilating the room and adjusting the blinds, and try to be helpful to one another. Through their classroom instruction they learn important facts about anatomy, physiology, and hygiene. In their interesting class work they often make health posters, write health songs and plays, and present health pageants.

295. Child welfare. The wide-awake community is interested in the welfare of the preschool child. It provides for clinics and out-patient departments in hospitals, where mothers may get information and training in the care of children. There they learn about proper feeding, clothing, and general hygiene.

Some communities have established habit clinics for the relief of children who have formed bad habits. For example, there is the tantrum child, the child who fusses about his food, and the jealous child. All these children have formed bad habits. The tantrum child has learned that he can have his own way by having tantrums, so he continues to have them until he becomes a spoiled child. The doctor in charge advises the parents as to what they are to do. Possibly your teacher may tell you some interesting stories about the habit clinic as told in a book by the founder of habit clinics.[1]

296. The health of the worker. As boys and girls leave school and enter the trades and industries their health should be adequately protected. Manufacturing establishments should always provide a healthful environment. Lighting, heating, ventilating, cleanliness, safety, medical

[1] Dr. Douglas Thom, Everyday Problems of the Everyday Child. D. Appleton and Company, New York.

attention in case of injury, and opportunity for recreation are among the things needed. Before entering an industry every boy and girl should know something about its health hazards and understand their own physical condition (see Chapter XXI).

297. Safety. In this machine age, when there is so much danger, especially from automobile traffic, every community should provide for the safety of its citizens. This means well-trained traffic officers, and intelligent, thoughtful citizens (see Chapter V).

There is plenty of evidence to show that any city may reduce the number of its accidents by intensive educational work. During a six months' period Albany, New York, by such methods, showed the following improvement as compared with the experience of the corresponding months of the previous year:

31 per cent fewer accidental deaths from all causes.
71 per cent fewer accidental deaths in the home.
50 per cent fewer accidental deaths in industry.
11 per cent fewer fatal traffic accidents.
10 per cent fewer nonfatal traffic accidents.
$33\frac{1}{3}$ per cent fewer nonfatal traffic accidents involving children.

In this campaign, in which the press, Safe Drivers' Club, and other organizations took part, all accidental deaths were reduced 31 per cent. During this time not a single school child lost his life through accident.

298. The broader community health. The ease of communication between peoples the world over makes every citizen a member of a large community. We are not only citizens of a small community, like our neighborhood, village, town, or city, but also members of a state and nation. Yes, we are even members of a much larger

community. An outbreak of cholera or influenza in a distant land is a matter of world importance, because it may be spread, by way of railroads and ships, to our country. It may be carried by people who have the disease or, in the case of cholera, by rats. It is therefore desirable for all nations to coöperate in the prevention of disease. The League of Nations, with its headquarters at Geneva, Switzerland, has a section devoted to international health. In this work our own country enthusiastically coöperates.

In a sense, then, we are all members of the great community, the world. To the extent that we earnestly endeavor to improve our own health and that of our community and nation, we may be proud to call ourselves worthy citizens of the world.

Questions that Every Pupil should be able to Answer about his Community

1. Is my community wide awake on matters pertaining to the public health? Why or why not?

2. As compared with surrounding communities, are its citizens public-spirited?

3. What evidence have you that the citizens look after their individual health?

4. What laws does your community have about housing?

5. What are the conditions found in a healthful home?

6. What recreation does your community provide for its citizens?

7. How much money per capita does your town, city, county, and state spend on public health each year?

8. Are your milk supply and water supply well protected?

9. Are your restaurants, soda fountains, and barber shops conducted in a sanitary way?

10. Is food that is sold in stores protected from flies, dust, and handling?

11. Are ashes and waste paper adequately disposed of? How?

12. How is the sewage of the community disposed of?

13. Is your school building sanitary in every respect? Describe its advantages and disadvantages.

14. In what way are the pupils in your school training themselves in healthful living?

15. What evidence is there to show that your community takes an interest in child welfare?

16. Are the lives of the citizens protected against automobile accidents? How?

17. What provisions are made for the health of men and women who work in factories?

Interesting Things to Do

1. Make a survey of the sanitation of another school building besides your own.

2. Try to find in a newspaper or a magazine some interesting items about community health.

SUGGESTIONS TO THE TEACHER ON WEIGHING AND MEASURING

1. Every pupil should gain in weight and grow in height through the school year.

2. Children should be weighed regularly each month and measured three times per year. Height should be taken in September, February, and June.

3. For weighing and measuring, the American Child Health Association gives the following directions:

Remove outdoor clothing, shoes, coat or sweater.

Take height with a square, consisting of two flat pieces of wood joined at right angles (a chalk box will serve). Place child in an erect position, with heels and shoulders against the wall or wide board upon which has been marked or pasted an accurate measure.

Be sure the scales are balanced.
Have child stand in center of the scale platform.
Take weight to the nearest half-pound.
Take height to the nearest half-inch.
Take age to the nearest birthday.

4. On the next page is a sample of a chart for recording height and weight and also a graph representing the monthly weighings. Every pupil should be guided in keeping similar records.

5. In making the graph the pupil's weight in September should be recorded on the broad black line at the left of the X. The numbers in the blank spaces under Weight should then be arranged in an ascending and descending series for the following months. Each month an X should be put where the weight line crosses the month line. Then connect the X's with straight lines. The slanting line will show the growth. The form on page 349 may be copied by the teacher or pupils.

6. It is the business of the child to grow. A continued loss of weight or failure to gain over two or three months should be brought to the attention of the school physician or to that of the parents, so that they may seek the advice of the family physician.

7. The teacher may aid children in growth by inculcating habits and attitudes of healthful living. Among the factors favorable to growth are long hours of sleep, play and exercise in the open air, and a diet that includes a generous amount of milk, fruit, and vegetables.

8. **It is more important to know that a child is gaining than that he or she weighs any particular amount at a certain time.**

The teacher should study the individual trends of children.

9. A classroom growth record may be secured from the American Child Health Association, 370 Seventh Avenue, New York City. A record for an individual pupil, similar to the one on the next page, has been prepared by Thomas D. Wood, M.D., and Annette M. Phelan, M.A., and may be ordered through the Bureau of Publications, Teachers College, Columbia University, New York City.

GROWING UP

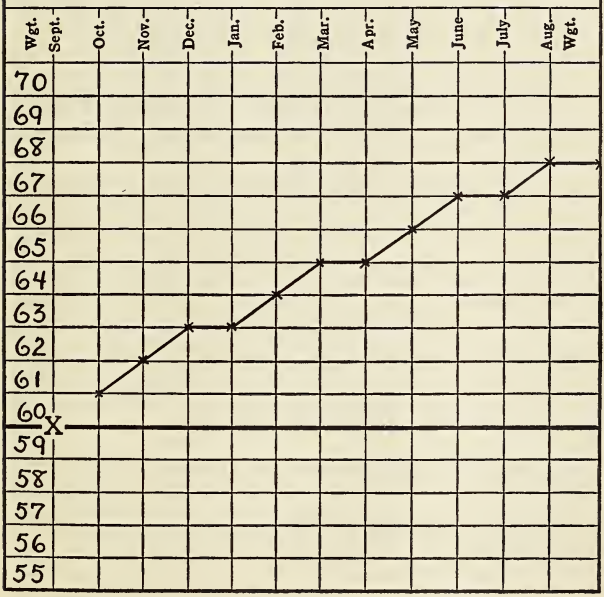
NAME_____

DATE OF BIRTH_____ AGE AT NEAREST BIRTHDAY___

_____ 19____ TO_____ 19___

I am Gaining in Height and Weight

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
Height												
Weight												
Gain in Weight												



APPENDIX

THE USE OF WEIGHT-HEIGHT-AGE TABLES[1]

(Directions of the United States Bureau of Education)

1. *Take the height first.* Nail an accurate measure on the wall. Two yardsticks, a new tape measure, or a drawn scale will serve. Let the child stand, without shoes, flat against the wall, with heels, shoulders, and head touching the wall, and place a right-angled piece of wood (a chalk box will answer) firmly over his head and against the measuring scale.

2. *What is the child's age?* Take the nearest birthday.

3. *Then consult the chart for the proper weight for this child's age and height.* First find the height in the left column and follow across the chart to the appropriate age column. The figure so found is what this child should weigh.

4. *Now weigh the child.* Have the child, in indoor clothing but without shoes, stand in the *center* of the scale platform. Teach the child to weigh himself, but in the monthly weighings the teacher should do the weighing.

5. *Next, the record.* Enter the weight on the classroom weight record. State the monthly weight on the monthly report card. Use one record for each section of the class and pass on with the section when promoted.

6. *Since this chart is chiefly for its educational value, the health lesson is the most important part of the procedure.* Emphasize the need of weight gains each month. Study foods and their relation to growth. Study health habits and their effect upon the weight curve.

[1] These new Weight-Height-Age Tables are a revision, by Bird T. Baldwin and Thomas D. Wood, of the Wood tables formerly used. The figures represent a large group of presumably healthy children, most of whom are native born. These figures are believed to be the most accurate available.

WEIGHT-HEIGHT-AGE TABLE FOR BOYS

Height Inches	5 Yr.	6 Yr.	7 Yr.	8 Yr.	9 Yr.	10 Yr.	11 Yr.	12 Yr.	13 Yr.	14 Yr.	15 Yr.	16 Yr.	17 Yr.	18 Yr.	19 Yr.
38	34	34													
39	35	35													
40	36	36													
41	38	38	38												
42	39	39	39	39											
43	41	41	41	41											
44	44	44	44	44											
45	46	46	46	46	46										
46	47	48	48	48	48										
47	49	50	50	50	50	50									
48		52	53	53	53	53									
49		55	55	55	55	55	55								
50		57	58	58	58	58	58	58							
51			61	61	61	61	61	61							
52			63	64	64	64	64	64	64						
53			66	67	67	67	67	68	68						
54				70	70	70	70	71	71	72					
55				72	72	73	73	74	74	74					
56				75	76	77	77	77	78	78	80				
57					79	80	81	81	82	83	83				
58					83	84	84	85	85	86	87				
59						87	88	89	89	90	90	90			
60						91	92	92	93	94	95	96			
61							95	96	97	99	100	103	106		
62							100	101	102	103	104	107	111	116	
63							105	106	107	108	110	113	118	123	127
64								109	111	113	115	117	121	126	130
65								114	117	118	120	122	127	131	134
66									119	122	125	128	132	136	139
67									124	128	130	134	136	139	142
68										134	134	137	141	143	147
69										137	139	143	146	149	152
70										143	144	145	148	151	155
71										148	150	151	152	154	159
72											153	155	156	158	163
73											157	160	162	164	167
74											160	164	168	170	171

WEIGHT-HEIGHT-AGE TABLE FOR GIRLS

Height Inches	5 Yr.	6 Yr.	7 Yr.	8 Yr.	9 Yr.	10 Yr.	11 Yr.	12 Yr.	13 Yr.	14 Yr.	15 Yr.	16 Yr.	17 Yr.	18 Yr.
38	33	33												
39	34	34												
40	36	36	36											
41	37	37	37											
42	39	39	39											
43	41	41	41	41										
44	42	42	42	42										
45	45	45	45	45	45									
46	47	47	47	48	48									
47	49	50	50	50	50	50								
48		52	52	52	52	53	53							
49		54	54	55	55	56	56							
50		56	56	57	58	59	61	62						
51			59	60	61	61	63	65						
52			63	64	64	64	65	67						
53			66	67	67	68	68	69	71					
54				69	70	70	71	71	73					
55				72	74	74	74	75	77	78				
56					76	78	78	79	81	83				
57					80	82	82	82	84	88	92			
58						84	86	86	88	93	96	101		
59						87	90	90	92	96	100	103	104	
60						91	95	95	97	101	105	108	109	111
61							99	100	101	105	108	112	113	116
62							104	105	106	109	113	115	117	118
63								110	110	112	116	117	119	120
64								114	115	117	119	120	122	123
65								118	120	121	122	123	125	126
66									124	124	125	128	129	130
67									128	130	131	133	133	135
68									131	133	135	136	138	138
69										135	137	138	140	142
70										136	138	140	142	144
71										138	140	142	144	145

DIRECTIONS FOR TESTING SIGHT AND HEARING

Method of Testing Sight.[1] Place the vision chart in a good light at a height to bring the smallest letters (line No. 10) about on a line with the eyes of the child being tested. The distance from the chart to the chair in which the child sits should be 19.7 feet. At 20 feet a sufficiently accurate test will result. An individual with normal vision will be able to read with each eye separately line No. 10 at the distance above specified.

Each eye should be examined separately. Hold a card over one eye while the other is being tested. Do not press upon the covered eye, as the pressure might induce an incorrect answer.

Have the one being examined begin at the top of the test chart and read aloud down as far as the letters can be distinguished, first with one eye and then with the other. The degree of visual acuity is determined by the smallest letters that can be deciphered at the proper testing distance. If an individual can, with the right eye alone, read without error (or with one or two mistakes) all the letters in line No. 10, the right eye has normal vision. If the left eye is tested and found to see not better than the letters in line No. 5, the left eye has 5/10 vision, as indicated by the figures to the right of that line of letters.

If the one making the examination suspects that the child is memorizing the letters, have the child read them from right to left, or examiner may easily check by going to the chart and having the child call the letters as indicated by the examiner pointing to them out of rotation.

For the use of children who do not know the name of letters, the symbol " E " has been placed on each line in various positions. The one being examined should indicate in which direction this character opens. This may be done by the child motioning with the hand whether the symbol opens up or down, or to the right or to the left as the case may be. The child may be instructed to hold the three middle fingers of the hand in the position of the symbol as pointed out on the chart, or there may be cut out of cardboard the symbol " E," which the child may hold in the hand, turning it to the same position as that of the symbol pointed out on the vision chart.

The parents or guardian of any child who has less than normal vision

[1] Used by courtesy of The Eye Sight Conservation Council. The vision chart (33 in. × 12 in.) for schools may be procured at nominal cost from The Eye Sight Conservation Council of America, Times Building, New York City.

VISION CHART FOR SCHOOLS[1]

[1] This reproduction of the vision chart is about one fourth of the actual size and should not be used for testing.

in either eye should be notified that the test made at the school indicates defective vision and that a reliable specialist should be consulted.

It is recommended, where it is not already a rule of the school, that records be maintained of all tests for visual acuity; so that when subsequent examinations are made in following years, any increased defect will be noted.

Many children with normal vision have red eyes, may complain of headaches, and be backward in school. These conditions may result from latent errors of refraction not indicated by vision less than normal. Do not take for granted that perfect vision means freedom from defects, as normal vision does not necessarily indicate a normal eye.

More detailed instruction for the use of the chart will be found in Bulletin No. 2, published by The Eye Sight Conservation Council, Times Building, New York City.

Method of Testing Hearing.[1] If it is possible, one person should make the examinations for an entire school in order to insure an even method. The person selected should be one possessed of normal hearing, and preferably one who is acquainted with all the children, the announcement of an examination often tending to inspire fear.

The examinations should be conducted in a room not less than 25 or 30 feet long, and situated in as quiet a place as possible. The floor should be marked off with parallel lines one foot apart. The child should sit in a revolving chair on the first space.

The examination should be made with the whispered or spoken voice; the child should repeat what he hears, and the distances at which words can be heard distinctly should be noted.

The examiner should attempt to form standards by testing persons of normal hearing at normal distances.

In a still room the standard whisper can be heard easily at 25 feet; the whisper of a low voice can be heard from 35 to 45 feet and of a loud voice from 45 to 60 feet.

The two ears should be tested separately.

The test words should consist of numbers 1 to 100, and short sentences. It is best that but one pupil at a time be allowed in the room, to avoid imitation.

[1] Used by courtesy of the Massachusetts Department of Education.

Food Value of an Average Serving of Certain Food Materials[1]

Food	Important Nutrients Present												
	Approximate amount of one serving				Percentage of the total daily requirement for an average adult			Distribution of					
								Vitamins			Calories		
	Measure	*Weight, ounces*	*Total calories*	*Protein, grams*	*Calcium, per cent*	*Phosphorus, per cent*	*Iron, per cent*	*A*	*B*	*C*	*Protein*	*Fat*	*Carbohydrate*
Milk and Milk Products:													
Milk, whole	½ pt.	8½	170	8.5	44.1	17.2	3.9	+++	++	+	34	88	48
Buttermilk	½ pt.	8⅘	89	7.3	39.0	18.3	4.1	+	++	+	29	12	48
Cheese, American	cube 1 in.	⅔	89	5.8	28.1	10.5	1.8	++	*	*	23	63	3
Cheese, cottage	3⅔ T.[2]	2	62	12.3	8.5	14.0	.....	+	*	*	49	2	11
Cream, thin	2 T.	1	50	0.5	3.7	1.7	0.3	+++	++	+	2	43	5
Butter	pat 1 T.	½	100	0.3	0.3	0.1	0.2	+++	−	−	1	99	
Ice cream	⅔ cup	5	320	3.3	13.2	5.9	1.2	++	++	+	13	202	105
Fat and Salad Oils:													
Animal fat	1 T.	⅔	100	....	.....	.....	.....	− to +	−	−	....	100	
Olive oil	1 T.	⅔	100	....	.....	.....	.....	− ?	−	−	....	100	
Cottonseed oil	1 T.	⅔	100	....	.....	.....	.....	?	−	−	....	100	
Bread and Cereals:													
Bread, white	1 slice 3 × 3½ × ½ in.	⅔	50	1.8	0.8	1.3	1.2	?	+	−	7	3	40
Graham bread	1 slice 3¼ × 2 × ⅜ in.	½	33	1.3	0.9	2.1	2.1	+	++	?	5	2	26

* No data have been obtained.

[1] Compiled from various sources: Rose, a Laboratory Handbook for Dietetics; Rose, Feeding the Family; Sherman, Food Products; and others.

[2] T. = tablespoonful.

Food Value of an Average Serving of Certain Food Materials (continued)

Food	Important Nutrients Present													
	Approximate amount of one serving				Percentage of the total daily requirement for an average adult			Distribution of						
								Vitamins			Calories			
	Measure	*Weight, ounces*	*Total calories*	*Protein, grams*	*Calcium, per cent*	*Phosphorus, per cent*	*Iron, per cent*	*A*	*B*	*C*	*Protein*	*Fat*	*Carbohydrate*
Bread and Cereals (*Cont.*):													
Boston brown bread	½ in. slice, 3 in. diam.	1⅕	67	1.8	5.6	4.1	5.7	*	*	*	7	6	54
Bran, wheat . . .	¼ cup	⅗	54	2.0	3.2	16.3	9.2	+	++?	–	8	3	43
Corn meal, cooked	⅔ cup	6	100	2.5	0.7	4.0	2.0	– to +	++	–	10	5	85
Hominy grits, cooked	½ cup	4⅘	70	1.5	0.2	1.4	1.2	*	*	*	6	1	63
Macaroni, cooked .	½ cup	2⅗	50	1.8	0.4	1.5	1.1	*	*	*	7	1	42
Oatmeal, cooked .	⅔ cup	5¼	67	2.8	1.7	5.0	4.3	– to +	++	–	11	11	45
Rice, brown, steamed	¾ cup	4	100	2.5	0.4	4.5	3.9	+	++	–	10	7	83
Rice, white, steamed	¾ cup	4	100	2.3	0.1	2.0	1.7	–	–	–	9	1	90
Eggs:													
Egg, whole, in shell	1 egg	2½	70	6.3	4.7	6.5	9.5	++	+	–	25	45	
Egg white	1	1	14	3.3	0.4	0.2	0.2	–	*	–	13	1	
Egg yolk	1	⅗	56	2.8	3.0	5.0	8.6	+++	+	–	11	45	
Meats, Fish, and Poultry:													
Bacon, cooked . .	4–5 small slices	½	100	3.3	0.3	2.6	3.2	– to +	+	?	13	87	
Beef, lean, round, broiled	2 slices, 4×3 × 1⅛ in.	4	200	24.0	2.0	19.6	24.0	– to +	+	– to +	96	104	

FOOD VALUE OF AN AVERAGE SERVING OF CERTAIN FOOD MATERIALS (CONTINUED)

Chicken, roast . .	1 slice, 4 × 2½ × ¼ in.	1⅔	100	12.8	1.1	10.4	12.7	*	+	*	51	49	
Fish, lean, broiled .	1 slice, 4 × 2¼ × 1 in.	4	133	20.3	3.3	17.6	7.4	− to +	+	*	81	52	
Ham, boiled . . .	1 slice, 4¾ × 6 × ⅛ in.	2	150	11.0	0.9	8.9	11.0	− to +	+	−	44	106	
Lamb chop, broiled	1 chop	1⅔	100	10.0	0.9	8.1	10.0	*	+	*	40	60	
Lamb, roast . . .	1 slice, 3½ × 4½ × ⅛ in.	1⅛	100	10.3	0.9	8.4	10.2	*	+	*	41	59	
Liver, calf's, broiled	medium-size serving	2⅘	100	15.5	1.3	12.6	15.5	++	++	+	62	38	
Mutton, roast . .	1 slice, 3 × 3¾ × ¼ in.	1⅓	100	8.3	0.7	6.7	8.2	− to +	+	?	33	67	
Oysters, raw . . .	½ cup	5⅖	75	9.3	11.9	17.4	44.6	*	*	+	37	18	20
Pork chop, lean, broiled	1 chop	2⅖	200	16.0	1.4	13.1	16.1	− to +	+	−	64	136	
Veal leg, lean, broiled	1 serving	4⅓	150	26.3	2.2	21.2	26.1	*	+	*	105	45	
Vegetables:													
Asparagus	4 stalks 4 in. long	1½	10	0.8	1.8	1.3	3.0	*	+++	*	3	1	6
Beans, lima, dried .	¼ cup	2	200	10.5	6.0	14.5	26.7	*	*	*	42	8	150
Beans, lima, fresh .	½ cup	3	100	5.8	3.4	8.3	11.0	*	*	*	23	5	72
Beans, dried[1] . . .	¼ cup	1⅜	171	11.3	12.0	17.7	23.1	+	+++	*	45	8	118
Beans, string, fresh.	⅓ cup	1⅓	15	0.8	2.5	1.4	2.7	++	++	++	3	1	11
Beets	½ cup cubes	2	25	0.8	2.4	1.6	2.2	*	+	*	3	1	21

[1] NOTE. Dry beans are seen to be quite low in vitamin C, the antiscorbutic vitamin. However, sprouted beans contain it. The following directions for managing the sprouting of beans are furnished by the Bureau of Home Economics, United States Department of Agriculture. In this case Chinese (Mung) beans were used, but more common varieties have been found satisfactory. Soak the beans to be sprouted overnight. The next morning place them in a colander or other container having holes for drainage. Keep them covered and in a warm place. Flood with warm water at least four or five times daily. They will sprout in from three to five days. The outer covering of the beans can then be removed by washing. The sprouts are good either raw or cooked and combine well with most vegetables. Naturally the sprouts are as perishable as any fresh vegetable and should be grown only as needed.

Food Value of an Average Serving of Certain Food Materials (continued)

Food	Important Nutrients Present												
	Approximate amount of one serving				Percentage of the total daily requirement for an average adult			Distribution of					
								Vitamins			Calories		
	Measure	*Weight, ounces*	*Total calories*	*Protein, grams*	*Calcium, per cent*	*Phosphorus, per cent*	*Iron, per cent*	*A*	*B*	*C*	*Protein*	*Fat*	*Carbohydrate*
Vegetables (*Cont.*)													
Cabbage, chopped	½ cup	1½	10	0.5	2.1	0.7	2.3	+	++	+++	2	1	7
Carrots, cooked	2 medium	4	40	1.0	7.4	3.0	3.5	++	+	+	4	2	34
Cauliflower	⅓ small head	2⅓	20	1.3	12.0	3.0	2.6	+	++	+	5	3	12
Celery	½ cup	1⅓	6	0.5	3.8	0.9	1.1	+	++	*	2	....	4
Corn, fresh	1 ear 6 in.	4½	50	1.5	0.4	3.9	2.6	+	++	–	6	4	40
Corn, canned	½ cup	3⅔	100	2.8	0.9	7.7	5.3	*	*	*	11	11	78
Cucumber	⅔ cucumber 7 in. long	3½	16	0.8	2.1	2.3	1.2	*	+	++?	3	2	11
Dandelion greens	½ cup	4½	75	3.0	19.3	6.6	22.0	++	++	+	12	11	52
Lentils, dried	3¾ T.	1½	150	11.0	6.9	14.3	24.7	*	++	–	44	4	102
Lettuce	½ head	2½	12	0.8	4.0	2.0	6.3	++	++	+++	3	2	7
Okra	5 to 6 pods	2	20	0.8	6.7	0.8	.....	*	++	*	3	1	16
Onions	3 to 4 medium	7⅓	100	3.3	10.3	7.0	6.7	– to +	++	++	13	6	81
Parsnips	½ cup slices	3	50	1.3	6.8	4.4	3.0	–?	++	*	5	3	42
Peas, dried	¾ cup	2⅔	253	17.5	9.8	23.0	27.8	+	++	?	70	6	177
Peas, fresh	⅔ cup	1⅔	50	3.5	2.1	4.8	5.7	++	++	++?	14	2	34
Potato, white, boiled 15 min.	1 medium	3½	100	2.8	2.4	5.2	10.4	+	++	++	11	1	88
Potato, sweet, baked	1 medium	6	200	3.0	4.7	5.6	5.4	++	+	*	12	10	178

FOOD VALUE OF AN AVERAGE SERVING OF CERTAIN FOOD MATERIALS (CONTINUED)

Rutabaga, raw . .	⅔ cup	2	17	0.5	4.7	1.8	.....	−?	++	++	2	1	14
Spinach, cooked . .	⅝ cup	5¼	25	0.8	10.5	5.4	25.1	+++	+++	+	3	2	20
Squash, cooked . .	½ cup	3⅞	55	1.0	3.2	1.4	4.8	++	*	*	4	5	46
Tomato, fresh . .	1 small	3½	25	1.0	1.9	2.1	2.9	++	+++	+++	4	4	17
Turnip, cubes, raw	½ cup	2¼	25	0.8	6.0	2.2	2.1	− to +	++	++	3	1	21
Fruits, Fresh:													
Apple	½ large	3¾	50	0.5	0.9	0.7	1.6	+	+	+	2	3	45
Banana	1 medium	4⅛	75	1.0	1.0	1.8	3.0	+?	+	+	4	4	67
Blackberries . . .	½ cup	6	100	2.3	4.3	4.4	6.9	*	*	*	9	16	75
Cantaloupe	½ melon	9	50	0.8	3.3	1.4	2.4	*	*	*	3	....	47
Cherries, stoned . .	¼ cup	1⅛	25	0.3	0.9	0.7	0.8	*	*	*	1	2	22
Cranberries, fresh .	½ cup	2	25	0.3	1.4	0.5	2.1	*	*	+	1	3	21
Grapefruit	½ large	7½	100	1.8	5.9	2.7	3.9	*	++	++?	7	4	89
Grapes, white . . .	22	3⅔	100	1.3	2.8	2.4	2.1	*	+	+	5	15	80
Huckleberries . . .	½ cup	2½	50	0.5	2.0	0.4	4.0	*	*	*	2	4	44
Lemon juice . . .	1 T.	½	5	....	0.4	.....	.....	?	++	+++	....	....	5
Olives, green . . .	4 medium	⅘	50	0.3	3.0	0.1	3.2	*	*	*	1	41	8
Orange	1 medium	7⅛	75	1.3	9.8	2.3	1.9	+	++	+++	5	2	68
Orange juice . . .	½ cup	4	50	....	5.0	1.4	1.5	+ to ++	++	+++	....	....	50
Peaches	3 medium	10½	100	1.5	5.7	4.3	4.9	*	*	++	6	3	91
Pears	2 medium	6⅓	100	1.0	3.6	3.1	3.1	*	+	*	4	6	90
Pineapple	2 slices 1 in. thick	8⅕	100	1.0	6.1	4.8	7.7	+	+	++	4	6	90
Plums	3–4 large	4⅘	100	1.3	3.6	2.9	3.9	*	*	*	5	....	95
Raspberries . . .	⅘ cup	1¾	33	0.8	3.6	1.9	2.0	*	*	++	3	5	25
Rhubarb	1 cup	3⅘	25	0.5	7.0	2.5	7.2	*	*	+	2	7	16
Strawberries . . .	¾ cup	4½	50	1.3	7.8	2.7	6.8	*	+	++	5	7	38
Fruits, Dried:													
Apricots	9 halves	1⅓	100	1.8	3.4	3.3	3.5	*	*	*	7	3	90
Dates, unstoned .	3–4	1	100	0.5	2.8	1.2	5.7	*	*	*	2	7	91
Figs	3 large	2⅓	200	2.5	15.2	5.6	12.7	*	*	*	10	2	188
Prunes	4 medium	1⅔	100	0.8	2.7	2.6	6.7	+	+	−	3	....	97
Raisins	¼ cup	1	100	0.8	2.8	2.9	9.3	−	+	−	3	9	88

Food Value of an Average Serving of Certain Food Materials (continued)

Food	Important Nutrients Present													
	Approximate amount of one serving				Percentage of the total daily requirement for an average adult			Distribution of						
								Vitamins			Calories			
	Measure	*Weight, ounces*	*Total calories*	*Protein, grams*	*Calcium, per cent*	*Phosphorus, per cent*	*Iron, per cent*	*A*	*B*	*C*	*Protein*	*Fat*	*Carbohydrate*
Nuts:														
Almonds	12–15 nuts		100			5.4	4.0							
Peanuts	20–24	$\frac{1}{2}$		3.3	5.5			+	+	*	13	76	11	
	single nuts	$\frac{3}{5}$	100	4.8	1.9	5.5	2.4	+	++	*	19	63	18	
Pecans	12 meats	$\frac{1}{2}$	100	1.3	1.8	3.4	2.3	*	+	*	5	87	8	
English walnuts	8–16 meats	$\frac{1}{2}$	100	2.8	1.9	1.1	2.0	*	++	*	11	82	7	
Sugar and Sweets:														
Sugar	1 T.	$\frac{2}{5}$	50	....	.....	.....	.....	—	—	—	....	....	50	
Honey	1 T.	1	100	0.3	0.3	0.4	2.0	—	+	—	1	....	99	
Maple sirup	2 T.	$1\frac{3}{5}$	133	....	7.3	0.3	8.9	*	*	*	....	....	133	
Molasses	2 T.	$1\frac{3}{5}$	133	1.0	14.7	1.5	22.6	*	+	*	4	....	129	
Corn sirup	$1\frac{3}{4}$ T.	$1\frac{1}{2}$	100	....	.....	.....	.....	*	*	*	....	....	100	
Gingerbread, plain	piece, 2 × $1\frac{3}{4}$ × 2 in.	$2\frac{1}{5}$	200	3.5	11.7	3.2	18.0	*	*	*	14	42	144	
Sponge cake, 2 eggs, hot water	piece, 3 × $2\frac{3}{4}$ × $\frac{7}{8}$ in.	$1\frac{1}{2}$	150	2.8	1.6	2.5	2.9	*	*	*	11	10	129	

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KEY. āle, senâte, ăt, câre, ásk, ärm, finạl, all; ēve, ẽvent, ĕnd, hēr, recẹnt; īce, ĭll, admi̯ral; ōld, ôbey, ŏn, fôr, anchọr; ūse, ûnite, ŭp, fûr, circụs, menü; fo͝od, fo͝ot; ch *as in* chop; g *as in* go; ng *as in* sing; n̰ *as in* ink; th *as in* thin; th *as in* the; oi *as in* oil; ou *as in* noun.

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